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FIFTH ANNUAL REPORT

OF THE

Wellington College

NATURAL SCIENCE SOCIETY,

DECEMBER, 1873—DECEMBER, 1874.

> "Τὰ γὰρ ἀόρατα αὐτοῦ ἀπὸ κτίσεως κόσμου τοῖς ποιήμασι νοούμενα καθορᾶται, ἥ τε ἀΐδιος αὐτοῦ δύναμις καὶ Θειότης."
>
> Ἐπιστολὴ πρὸς Ῥωμαιους, I. 20.

WISCONSIN ACADEMY
OF
SCIENCES, ARTS, AND LETTERS

WELLINGTON COLLEGE,
GEORGE BISHOP.
1875.

FIFTH ANNUAL REPORT

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WELLINGTON COLLEGE,
GEORGE BISHOP.

1875.

AS
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5

PREFACE.

In issuing the Fifth Annual Report of the Wellington College Natural Science Society we feel that a few words are necessary by way of Preface.

The general interest taken in natural science during the year has not fallen off; the average attendance of members and visitors at the fornightly meetings has increased; and the work done in the several departments of Botany, Entomology, and Zoology is fully up to the standard of former years

The Society has lately had to deplore the loss of its oldest corresponding member—the Rev. Canon Kingsley, who from the first took a great interest in its proceedings, and on many occasions gave us several most interesting Lectures.

The thanks of the Society are due (1) to the Rev. Canon Tristram for his able and eloquent Lecture on the Natural History of Palestine, which was admirably illustrated by numerous specimens of quadrupeds and birds, collected by the Lecturer when travelling in Moab and the Holy Land;

(2) to Mr. H. D. Pender, O.W., (*a*) for his collection of Indian and Australian curiosities, exhibited early in the year on his return to England and (*b*), more especially for his instructive Paper on Torpedoes, and for the unsparing pains and expense with which his elaborate experiments in illustration of it were planned and carried out.

In conclusion, we think that the Natural Science Society has reason to congratulate itself on the work done during the past year, and may look forward with renewed energy and increased hope to a season of vigour and action in 1875.

WELLINGTON COLLEGE,
March, 1875.

RULES.

1. That this Society be called the "WELLINGTON COLLEGE NATURAL SCIENCE SOCIETY."

2. That the Society consist of Honorary Members, Corresponding Members, Fifteen Members, and Twenty-five Associates.

3. That all Members of the School having attended three meetings of the Society be eligible as Associates, and that Members be chosen from among the Associates who are of at least one term's standing, and in the Upper School.

4. That the Society's Officers consist of a President, Secretary, and Treasurer, and of the Keepers of the Albums.

5. That the Officers do form a Committee of Management, and that the Committee be empowered to invite not more than two Honorary Members to join them in their Meetings. In Meetings of the Committee, four to be a quorum.

6. That all Officers be elected annually at the last Meeting of the Midsummer term—the President from among the Honorary Members, the others from the Members.

7. That the President take the chair at all the Meetings, but have no vote except in cases of equality.

8. That the Secretary keep the Minutes of the Society's proceedings; a list of all persons present at each Meeting; a list of the existing Society, with the names and addresses, as far as possible, of all Honorary and Corresponding Members; and a list of all benefactors of the Society; and that he produce the Minutes at the last Meeting in each term.

9. That the Treasurer look after the property of the Society, collect subscriptions, and pay debts, producing his accounts whenever called upon by the President to do so,

10. That the duty of the several Album Keepers be to receive all notices connected with their several sections; to take care of the collections; to enter all occurrences of interest in their Albums; and at the last Meeting in each term to produce their Albums for the inspection of the Society.

11. That in the absence of any Officer the Committee appoint a Deputy.

12. That Honorary and Corresponding Members be elected by a vote of the Committee, and that Honorary Members have all the privileges of Members.

13. That Honorary Members pay an entrance fee of 10*s*. and a subscription of 1*s*. 6*d*. a term.

14. That Members or Associates, on leaving the School, are entitled to become Corresponding Members. Other Old Wellingtonians are *eligible for election* as Corresponding Members. Corresponding Members pay in advance a subscription of 6*s*. and receive in return the Society's Report for four years from the date of subscription. It shall also be in the power of the Committee to elect as Corresponding Members, without any subscriptions, persons who have lectured before the Society, and other Benefactors.

15. That Members and Associates be proposed and seconded by a Member or Honorary Member, and elected by the Members, their names, with those of the Proposer and Seconder, having previously been entered in the Candidate Book, to be kept by the Secretary.

16. That Members pay a subscription of 1*s*. 6*d*., and Associates of 1*s*. per term. No Member or Associate may attend any Meeting of the Society after the first of the term, unless he has first paid his subscription for the term.

17. That Members may speak at all *Meetings of the Society;* may read Papers, with the leave of the President; may introduce two visitors at all Public Meetings, or, if on the Committee, three; and receive a copy of the Society's Report.

18. That Associates may speak at all *Public* Meetings, and read Papers, with the leave of the President, and may introduce one visitor at all Meetings.

19. That Members and Associates provide with tickets the visitors whom they introduce at any Meeting, and that no visitors, except those who accompany Honorary Members, be admitted to any Meeting of the Society without such a ticket, but that in special cases the Committee be empowered to issue extra tickets. That the Sixth Form may attend all Public Meetings without tickets.

20. That any Member or Associate may be suspended or expelled from the Society by a vote of two-thirds of the Members present, if he, from any misdemeanour or want of energy, appear to deserve such suspension or expulsion.

21. That Meetings be ordinarily held once a fortnight, but that the Secretary be empowered to call Extraordinary Meetings when necessary.

22. That visitors may speak and read Papers at all Public Meetings, with the leave of the President.

23. That all objects intended for exhibition at any of the Society's Meetings be submitted to the President at least two days before, and that they be accompanied on exhibition with a written description.

24. That without notice given at the preceding Meeting no name be submitted to the Members for Membership or Association, nor any Member or Associate be suspended or expelled.

25. That the Editing Committee consist of the President, the Secretary, and one Member to be elected by the Society.

26. That no change be made in these Rules unless proposed by a Member or Honorary Member, and carried by a majority of the votes of the Members present at a subsequent Meeting.

LIST OF THE SOCIETY.

Officers.

President—REV. C. W. PENNY, F.L.S. Secretary—M. D. MALLESON.
Treasurer—B. C. STILWELL.

ALBUM KEEPERS.

Botanical—E. W. WILLETT. Entomological—J. L. BEVIR.
Geological—R. A. EDGELL. Zoological—J. F. W. GORE.

EDITING COMMITTEE.

Rev. C. W. PENNY. M. D. MALLESON. E. W. WILLETT.

HONORARY MEMBERS.

Rev. E. C. WICKHAM.
H. W. EVE, Esq.
Rev. A. CARR.
Rev. C. W. PENNY.
Rev. F. H. FREER.
A. F. GRIFFITH, Esq.
Rev. J. D. LESTER.
Rev. S. N. TEBBS.
Rev. P. H. KEMPTHORNE.
Rev. E. DAVENPORT.
O. AIRY, Esq.
Rev. J. B. SMITH.
E. A. A. SPENCER, Esq.
F. W. CAULFIELD, Esq.
S. G. TREMENHEERE, Esq.
O. ILBERT, Esq.
J. NIVEN, Esq.
H. D. PENDER, Esq.

CORRESPONDING MEMBERS.

Rev. Chancellor BENSON, D.D.

B. E. HAMMOND, Esq.
F. E. KITCHENER, Esq.
H. TOTTENHAM, Esq.
W. MOYLE, Esq.
C. J. LAMBERT, Esq.
E. H. C. SMITH, Esq.
M. J. SLATER, Esq.
W. C. POLLARD, Esq.
G. C. ALLEN, Esq.

MEMBERS.

B. C. STILWELL.
E. W. WILLETT.
H. D. BOYLE.
J. LAING.
A. LAING.
M. D. MALLESON.
R. A. EDGELL.
S. BALL.
F. C. HILL.
H. E. PRESCOTT.
J. L. BEVIR.
W. B. DAVIDSON.
N. FITZHERBERT
J. F. W. GORE.
J. T. SPEER.

ASSOCIATES.

J. W. WILLIAMSON.
P. B. HANHAM.
H. LAYARD.
F. H. C. CAPRON.
R. C. RINGROSE.
F. W. SCUDAMORE.
C. F. TINDAL.
J. B. ATLAY.
A. HAWKINS.
H. E. BELFIELD.
R. G. STRACHEY.
S. G. HAMILTON.
R. B. LAYARD.
H. HAVELOCK.
R. B. STEWART.
G. HERBERT.
M. KENNEDY.
W. D. FANSHAWE.
R. A. BOSTOCK.
F. W. BUNNY.
E. L. HANCOCK.
C. H. JONES.
W. L. JONES.
R. B. ALLEN.

ACCOUNTS, 1874.

RECEIPTS.

	£	s.	d.
Balance from last Report	5	2	10
Subscriptions, Easter, 1874	2	19	0
Ditto Midsummer, 1874 ..	4	11	0
Ditto Christmas, 1874 ..	6	4	0
Library Donation	5	0	0
By sale of Reports (less commission) ..	6	0	7
	£29	17	5

EXPENDITURE.

	£	s.	d.
Printing Reports	19	6	7
Stationery	0	2	0
Egg Cabinet	2	0	0
Balance in hand	8	8	10
	£29	17	5

B. C. STILWELL, *Treasurer.*

ZOOLOGICAL REPORT.

1874.

Additions to the List since the publication of the last Report. The initials refer to the following:—

N. G. B...	N. G. Benson.
G. L. T...	Sir G. L. Temple.
B. C. S. ..	B. C. Stilwell.
A. G.	A. Grey.

N.B.—The dates subjoined to each name indicate the date on which they were first seen.

CLASS II.—AVES.

ORDER III.—INSECTIVORES.

GENUS.—SILVIA.

Silvia sibilatrix	Wood Wren	June 27th	N.G.B.

ORDER IV.—GRANIVORES.

GENUS.—LOXIA.

Loxia curviostra	Crossbill	June 3rd	G.L.T.

ORDER XV.—PALMIPEDES.

GENUS.—ANAS.

Anas segetum	Wild Goose	March 24th	B.C.S.

GENUS.—STERNA.

Sterna minuta	Lesser Tern		——

One was shot at the lake in 1867.

CLASS IV.—PISCES.

ORDER.—MALACO-PTERYGII.

FAMILY.—ANGUILLIDAE.

GENUS.—ANGUILLA.

Anguilla acutirostris	Sharp-nosed Eel	March 16th	A.G.

CATALOGUE OF EGGS IN THE SOCIETY'S COLLECTION.

1874.

LIST OF DONORS.

J. L. B.	J. L. Bevir.
N. G. B.	N. G. Benson.
C. W. P.	Rev. C. W. Penny.
B. C. S.	B. C. Stilwell.
M. D. M.	M. D. Malleson.
F. C. G.	F. C. Gammell.
H. P. D.	H. P. Deeble.
E. W. W.	E. W. Willett.
F. M. G.	F. M. Glubb.
J. P. D.	J. P. Dagg.

Birds.		How obtained.		
Kestrel	1	presented by	F.C.G.	1 exchanged.
Sparrow Hawk	1	„	H.P.D.	
Barn Owl	1	„	J.L.B.	1 by H.P.D.
Carrion Crow	1	exchanged.		
Hooded Crow	1	presented by	B.C.S.	
Rook	2	exchanged.		
Jackdaw	2	presented by	B.C.S.	
Magpie	2	exchanged.		
Jay	1	presented by	B.C.S.	1 exchanged.
Starling	2	„	J.L.B.	
Red-backed Shrike	1	„	J.L.B.	1 by B.C.S.
Spotted Flycatcher	2	„	J.L.B.	
Missel Thrush	1	„	J.L.B.	1 by M.D.M.
Ring Ouzel	2	„	B.C.S.	
Song Thrush	1	„	F.M.G.	1 by M.D.M.
Blackbird	2	„	M.D.M.	
Hedge Sparrow	1	„	F.M.G.	1 by B.C.S.
Black Cap	2	„	J.L.B.	
Red Breast	1	„	M.D.M.	1 by F.M.G.
Sedge Warbler	2	„	B.C.S.	
Redstart	1	„	B.C.S.	1 by J.L.B.
Whitethroat	2	„	J.L.B.	
Lesser Whitethroat	1	„	M.D.M.	1 by B.C.S.

Birds.		How obtained.	
Willow Wren	2	presented by J.L.B.	
Chiff-chaff	1	exchanged.	
Nightingale	2	presented by J.L.B.	
Whinchat	1	exchanged.	
Gold-crested Wren	2	presented by N.G.B.	
Ray's Wagtail	1	„ J.L.B.	
Wood Wren	1	„ J.L.B.	
Dartford Warbler	2	„ J.L.B.	
Common Wren	2	„ J.L.B.	
Pied Wagtail	2	„ B.C.S.	
Tree Pipit	1	„ J.L.B.	
Meadow Pipit	2	„ B.C.S.	
Sky Lark	2	„ N.G.B.	
Wood Lark	1	„ B.C.S.	
Great Tit	2	„ J.L.B.	
Cole Tit	1	„ J.L.B.	
Blue Tit	2	„ N.G.B.	
Long-tailed Tit	2	„ B.C.S.	
Common Bunting	1	„ B.C.S.	
Yellow Bunting	2	„ J.L.B.	
Reed Bunting	1	„ N.G.B.	
Bullfinch	2	„ B.C.S.	
Greenfinch	1	„ J.L.B.	1 by B.C.S.
Chaffinch	1	„ J.L.B.	1 by M.D.M.
Linnet	2	„ B.C.S.	
Lesser Redpole	1	exchanged.	
House Sparrow	1	presented by B.C.S.	1 by N.G.B.
Cuckoo	2	„ J.L.B.	
Green Woodpecker	1	„ B.C.S.	1 by J.P.D.
Lesser Spotted Woodpecker	1	„ B.C.S.	
Wryneck	2	„ N.G.B.	
Tree Creeper	2	„ J.L.B.	
Swallow	1	„ B.C.S.	1 by J.L.B.
Nightjar	1	„ B.C.S.	
Ring Dove	1	„ N.G.B.	1 by H.P.D.
Stock Dove	1	„ F.M.G.	
Rock Dove	1	„ B.C.S.	
Turtle Dove	1	„ E.W.W.	
Pheasant	1	„ E.W.W.	
Quail	1	„ N.G.B.	
Partridge	1	exchanged.	
Golden Plover	1	presented by J.L.B.	
Lapwing	2	„ B.C.S.	
Common Snipe	1	exchanged.	
Moor Hen	2	presented by C.W.P.	
Coot	1	„ B.C.S.	
Little Grebe	2	„ N.G.B.	
Wild Duck	1	„ B.C.S.	
Ferruginous Duck	1	„ E.W.W.	
Ringed Plover	1	„ B.C.S.	
Redshank	2	„ B.C.S.	
Purple Heron	1	„ B.C.S.	
Common Tern	2	„ B.C.S.	
Lesser Tern	2	„ B.C.S.	
Black-headed Gull	1	„ B.C.S.	
Kittiwake	1	„ B.C.S.	
Herring Gull	1	„ B.C.S.	

Birds.		How obtained.
Great Black-backed Gull……	1	presented by B.C.S.
Lesser " " ……	1	" B.C.S.
Razor Bill………………	1	" B.C.S.
Guillemot………………	1	" B.C.S.

N.B. Any addition to the Society's collection will be thankfully received by B. C. Stilwell, and duly acknowledged in the Report.

J. F. W. GORE,

Zoological Album Keeper.

ENTOMOLOGICAL REPORT.

1874.

As we are this year publishing a list of the Natural Science Society's Collection of Diurni, we have thought it sufficient to publish merely the additions to the former list.

The following are the Collectors whose initials are placed after the specimens:—

M. D. M.	M. D. Malleson.
J. L. B.	J. L. Bevir.
F. S.	F. Sich.
J. W. L.	J. W. Loxdale.
W. B. D.	W. B. Davidson.
A. J. W. D.	A. J. W. Dowell.

FAMILIA I.—DIURNI.

Genus IV.—Vanessidæ.

Vanessa Polychloros	Large Tortoise-shell	July 23	J.L.B.

FAMILIA II.—NOCTURNI.

Genus I.—Sphingidæ.

Sphinx Elpenor	Elephant Hawk	July 6	J.W.L.

Genus II.—Sesidæ.

Sesia Apiformis	Hornet Clearwing	June 6	F.S.

Genus IX.—Lithosidæ.

Lithosia Rubricollis	Black Footman	July 17	M.D.M.

Genus XIII.—Bombycidæ.

Pecilocampa Ponuli	December Moth	Nov. 18.	A.J.W.D.

FAMILIA III.—GEOMETRÆ.

Genus II.—Ennomidæ.

Selenia Illustraria	Purple Thorn	July 11.	M.D.M.

Genus XI.—Fidonidæ.

Asphilates Citraria	Yellow Belle	July 3	W.B.D.

Genus XV.—Larecetidæ.

Cidaria Pyraliata	Barred Straw	July 18.	M.D.M.
„ *Psitticata*	Pied-Green Carpet	Oct. 20.	A.J.W.D.

FAMILIA V.—PSEUDOBOMBYCES.

Genus III.—Notodontidæ.

Stauropus Fagi	Lobster Moth	July 14.	F.S.

FAMILIA VI.—NOCTUÆ.

Genus I.—Trifidæ.

Cymatophora Duplaris	Lesser Satin Carpet	July 17	M.D.M.
„ *Flavicornis*	Yellow Horned	July 17	M.D.M.

Genus III.—Bryophilidæ.

Acronyeta Menyantidis	Light Knot Grass	June 29.	M.D.M.

Genus IV.—Genuinæ.

Leucania Impura	Smoky Wainscot	June 19.	M.D.M.

Genus V.——Apamidæ.

Mamestra Aberacca	Bright-line Brown-eye		M.D.M.

Genus VI.—Caradrinidæ.

Caradrina Morpheus	Mottled Rustic	July 12.	M.D.M.

Genus VIII.—Orthosidæ.

Orthosia Lota	Redline Maker	Oct. 14	J.L.B.
Xanthia Silago	Pink-barred Sallow	Oct. 12	A.J.W.D.

Genus X.—Hadenidæ.

Aplecta Nebulosa	Grey Arches	July 17	M.D.M.

FAMILIA IX.—PYRALIDES.

GENUS I.—PYRALIDÆ.

Aglossa Pinguinalis	Large Tabby	July 17..	M.D.M.

GENUS IX.—SCOPARIDÆ.

Endorea Pyralalis	Yellow Stigmed Grey
„ *Cembralis*	Large Grey
„ *Mercuralis*	Small Grey

FAMILIA XI.—TORTRICES.

GENUS II.—TORTRICIDÆ.

Tortrix Heparana	Dark Oblique Bar

GENUS III.—PENTHINIDÆ.

Antithasia Betulætana	Birch Long Cloak

GENUS VI.—SCIAPHIDÆ.

Crephasia Nubilana	Smoky Grey
„ *Logiana*	Logian

GENUS VII.—GRAPHOLITHIDÆ.

Pyrodes Rhediana	Rhedian
Coccyx Stiobilana	Light Silver Striped

GENUS IX.—COCHYLIDÆ.

Eupæcilia Maculosana	Small Black Spotted

FAMILIA XII.—TINEIDÆ.

GENUS II.—TINEIDÆ.

Tinea Tapetzella	Black Cloaked Woollen
Scardia Granella	Mottled Woollen

GENUS IV.—HYPONOMENTIDÆ.

Hyponomenta Padella	Common Ermine
„ *Cognatella*	Allied Ermine

GENUS VIII.—GRACILLARIDÆ.

Gracillaria Syringella	Confluent Barred

GENUS X.—ELACHISTIDÆ.

Elachista Cynipemella	Swan's Feather
„ *Flavicomella*	Yellow Headed Black

Recorded by the previous Secretary without dates.

J. L. BEVIR,
Entomological Album Keeper

4

BOTANICAL REPORT.

FLORA WELLINGTONENSIS.

The additions to this List are not many in number, as will be seen from the subjoined Catalogue; but we venture to say that, owing to the continued co-operation of those members of the sixth who were last year so energetic in this department, the reason of this is to be found in the fact that the List itself is almost complete. It has, therefore, been thought best to publish the *additions* only. The dates affixed to the plants indicate the dates when they were first discovered in flower. The initials refer to the following:—

C. W. P.	Rev. C. W. Penny.
E. W. W.	E. W. Willet.
P. A. W.	P. A. Willett.
M. D. M.	M. D. Malleson.
A. G...	A. Grey.
B. C. S.	B. C. Stilwell.

The numbers prefixed are those of the Sixth Edition of the London Catalogue of British plants.

IV. CRUCIFERÆ.

82. *Alyssum incanum.*	Sandhurst Railway Bridge, and near Finchampstead Church	*	C.W.P.
92. *Arabis Hirsuta.*	Wellington Coll. grounds	May 30.	M.D.M.

XII. CARYOPHYLLACEÆ.

166. *Mœnchia Erecta.*	Ridges	June 2.	C.W.P.

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* This plant was found last year, but inadvertently omitted in the List then published.

XXIV. ROSACEÆ.

328.	*Potentilla Argentea.*	Field beyond Heath Woods	June 18.	M.D.M.

XXXVIII. UMBELLIFERÆ.

455.	*Helosciadium inundatum.*	Ditches on the road* to Yately	May 30.	B.C.S.

XLIV. COMPOSITÆ.

669.	*Anthemis cotula.*	Darby Green	July 3.	M.D.M.

LXIX. EUPHORBIACEÆ.

968.	*Euphorbia cyparissias.*	Road to Yately	June 28.	A.G.

LXXXIV. JUNCACEÆ.

1159.	*Juncus supinus.*	Ditches on Starveall Farm	June 1.	M.D.M.

LXXXV. CYPERACEÆ.

1209.	*Carex stellulata.*	Wellington Coll. Lake	May 27.	M.D.M.
1214.	„ *remota.*	Heath Woods	May 30.	M.D.M.
1224.	„ *paniculata.*	Marsh below Brickfields	May 21.	M.D.M.
1236.	„ *pallescens.*	Roadsides, *passim*	May 10.	M.D.M.
1250.	„ *glauca.*	Wellington Coll. Lake	May 8.	M.D.M.

LXXXVI. GRAMINA.

1269.	*Phalaris arundinacea, passim*		May 26.	M.D.M.
1308.	*Avena stringosa.*	Pine Woods, *passim*	June 11.	B.C.S.
1311.	„ *flavrescens.*	Wellington Coll. grounds	June 2.	M.D.M.
1314.	*Holcus mollis.*	*Passim*	June 7.	M.D.M.
1326.	*Sclerochloa rigida.*	Wellington Coll. grounds	June 19.	B.C.S.
1328.	*Poa annua.*	*Passim*	May 1.	M.D.M.
1356.	*Bromus mollis.*	Meadows, *passim*	June 6.	M.D.M.

LXXXVII. FILICES.

1396.	*Asplenium trichomanes.*	Wellington Coll. grounds.	June 21.	E.W.W.
1410.	*Botrychium lunaria.*	Wellington Coll. grounds.	June 12.	P.A.W.
1411.	*Ophioglossum vulgatum.*	Meadows near the River Loddon.		Mrs. Lester

E. W. WILLETT,

Botanical Album Keeper.

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* This plant was discovered by C. W. P. and E. W. W. at Frimley, on June 14, 1873, and subsequently the same month at Yately Common.—C.W.P.

BRITISH BUTTERFLIES.

1874.

The Natural Science Society's collection of British butterflies having fallen into a very bad state, it has been re-arranged and added to. The following is a list of donors as signified by their initials.

Old Collection	O. C.
Rev. C. W. Penny	C. W. P.
J. L. Bevir	J. L. B.
M. D. Malleson	M. D. M.
S. G. Hamilton	S. G. H.

SECTION I.—Diurni.

		No.	Presented by.
Papilio Machaon	Swallow Tail	2	1, O.C. 1, J.L.B.
Gonepteryx Rhamni	Brimstone or Sulphur	4	J.L.B.
Colias Edusa	Clouded Yellow	3	J.L.B.
„ *Hyale*	Pale Clouded Yellow	3	J.L.B.
Pieris Cratægi	Black veined White	1	O.C.
Pontia Brassicæ	Large White	2	O.C.
„ *Rapæ*	Small White	2	O.C.
„ *Napi*	Green Veined	3	1, O.C. 2, J.L.B.
„ *Daplidiæ*	Chequered, or Bath White.		
„ *Sinapis*	Wood White	1	O.C.
Mancipium Cardamines	Orange Tip	4	2, O.C. 2, J.L.B.
Hipparchia Œgeria	Wood Argus	2	1, O.C. 1, J.L.B.
„ *Galathea*	Marbled White	1	O.C.
„ *Hyperanthus*	Wood Ringlet	2	O.C.
„ *Megæra*	Gatekeeper, or Wall	2	1,J.L.B. 1,M.D.M.
„ *Semele*	Rockeyed Underwing, or Grayling	3	2,J.L.B. 1,M.D.M.
„ *Tithonus*	Small Meadow Brown	2	J.L.B.
„ *Tanira*	Large Meadow Brown	4	J.L.B.
„ *Davus*	Heath, or Small Ringlet	2	O.C.
„ *Pamphilus*	Small Heath, or Least Meadow Brown	3	1, O.C. 2, J.L.B.
Limenitis Camilla	White Admiral	2	O.C.
Vanessa Atalanta	Red Admiral	2	O.C.
„ *Io*	Peacock Butterfly	2	1, O.C. 1, M.D.M.
„ *Polycloros*	Large Tortoiseshell	2	1, O.C. 1, J.L.B.
„ *Urticæ*	Small Tortoiseshell	2	1,C.W.P. 1,J.L.B.

		No.	Presented by.
Vanessa Antiopa	Camberwell Beauty	2	O.C.
Vanessa (C. album)	Comma Butterfly	2	O.C.
Cynthia Cardui	Painted Lady	2	O.C.
„ *Huntera*	Scarce Painted Lady	1	J.L.B.
Capatura Iris	Purple Emperor	2	1, O.C. 1, J.L.B.
Thecla Nuercus	Purple Hairstreak	2	O.C.
„ *Rubi*	Green Hairstreak	2	C.W.P.
„ *Betulæ*	Brown Hairstreak	1	O.C.
Nemeobius Lucina	Duke of Burgundy Fritillary	2	O.C.
Melitœa Artemis	Greasy, or Marsh Fritillary	2	O.C.
„ *Cinxia*	Glanville Fritillary	2	1, C.W.P. 1, J.L.B.
„ *Euphrosyne*	Pearl-bordered Fritillary	3	C.W.P.
„ *Selene*	Small, Pearl-bordered Fritillary	3	2, O.C. 1, J.L.B.
Argynnis Adippe	High Brown Fritillary	1	O.C.
„ *Aglaia*	Dark Green Fritillary	3	J.L.B.
„ *Paphia*	Silver-washed Fritillary	3	O.C.
Lycæna Dispar	Large Copper	1	O.C.
„ *Virgaurea*	Small Copper	2	J.L.B.
Polyommatus Argiolus	Holly Blue	2	1, O.C. 1 St.G.H.
„ *Alexis*	Common Blue	3	O.C.
„ *Corydon*	Chalk Hill Blue	4	2, O.C. 2, J.L.B
„ *Artaxerxes*	Brown Argus Blue	2	M.D.M.
Hesperia Malvæ	Grizzled Skipper	3	1, M.D.M. 2, C.W.P.
„ *Tages*	Dingy Skipper	3	O.C.
„ *Linear*	Small Skipper	3	2, O.C. 1, J.L.B.
„ *Silvanus*	Large Skipper	3	O.C. 2, St.G.H.

SECTION II.—NOCTURNI.

GENUS I.—SPHINGIDÆ.

Smerinthus Ocellatus	Eyed Moth	2, O.C. .. 1, J.L.B.
„ *Populi*	Poplar Hawk	1, O.C. .. 1, M.D.M.
„ *Tiliæ*	Lime Hawk	1, O.C.
Sphinx Ligustri	Privet Hawk	2, O.C. .. 1, J.L.B.
Acherontia Atropos	Death's Head Moth	2, O.C.
Sphinx Convolvuli	Convolvulus Hawk Moth	2, O.C.
Deilephila Euphorbiæ	Spurge Hawk Moth	1, O.C.
„ *Galii*	Bedstraw Hawk Moth	1, O.C.
„ *Livornica*	Striped Hawk Moth	2, O.C.
Chæro Campa Celerio	Silver-striped Hawk Moth	1, O.C.
„ *Elpenor*	Elephant Hawk Moth	1, C.W.P. 1, O.C.
„ *Porcellus*	Small Elephant Hawk Moth	2, O.C.
Macroglossa Stellatarum	Humming-bird Hawk Moth	2, O.C.
„ *Bombyliformis*	Narrow-bordered Bee Hawk Moth	1, O.C.

GENUS III.—ZEUZERIDÆ.

Zeuzera Æsculi	Leopard Moth	1, O.C.
Cossus Ligniperata	Goat Moth	3, O.C.

GENUS IV.—HEPIALIDÆ.

Hepialus Lupulinus	Common Swift	1, J.L.B.
„ *Velleda*	Northern Swift	1, O.C.

GENUS VI.—PROCRIDÆ.

Procris Statices	The Forester	2, J.L.B.. 1, O.C.

Genus VII.

Zygæna Loniceræ	Narrow-bordered Five-spot Burnett	3, O.C.	

Genus X.—Eucheliidæ.

Deiopeia Pulchella	Crimson Speckled	2, O.C.	
Euchelia Jacobæa	Cinnabar	1, O.C.	
Callimorpha Dominula	Scarlet Tiger	2, O.C.	

Genus XI.—Chelonidæ.

Euthemonia Russula	Clouded Buff	2, O.C.	
Chelonia Plantaginis	Wood Tiger	2, O.C.	
„ *Caja*	The Tiger	1, O.C.	1, J.L.B.
Arctia Mendica	Muslin Moth	2, O.C.	
„ *Urticæ*	White Ermine	2, O.C.	

Genus XII.—Liparidæ.

Liparis Salicis	Satin Moth	1, O.C.	
Orgyia pudibunda	Pale Tussock	1, O.C.	

Genus XIII.—Bombycidæ

Bombyx Neustria	Lackey	1, O.C.	
„ *Rubi*	Fox Moth	1, J.L.B.	1, O.C.
„ *Quercus*	Oak Eggar	2, J.L.B.	1, O.C.
Odonestis Potatoria	Drinker	1, J.L.B.	1, O.C.
Lasiocampa Quercifolia	Lappet	2, O.C.	
Endromis Versicolor	Kentish Glory	3, O.C.	
Saturnia Carpini	Emperor Moth	2, J.L.B.	1, O.C.

The families generally known as Geometers and Noctuas are in process of arrangement.

There have been added two new cabinets to the Natural Science Society's property in the library. In the one all the foreign insects, which have been suffering from exposure to the air, have been arranged by J. L. Bevir and B. C. Stilwell. The other is for British moths.

N.B. Any specimens of Moths will be thankfully received by J. L. Bevir for the N.S.S. Collection.

J. L. BEVIR,

Entomological Secretary.

MEETINGS OF THE SOCIETY HELD DURING THE YEAR 1874.

Saturday, February 21st.

E. W. Willett read a Paper on "The Charib Indians."

Present, 42.

Saturday, March 7th.

B. C. Stilwell read a Paper on "The Channel Passage."

Present, 39.

Saturday, March 28th.

F. W. Caulfield, Esq., read a Paper on "Natural Forms."

Present, 38.

Saturday, May 23rd.

G. H. Gordon read a Paper on "The Solar System."

Present, 50.

Saturday, June 6th.

Rev. P. H. Kempthorne read a Paper on "The Ancient Stone Monuments of Avebury."

Present, 52.

Saturday, July 4th.

J. F. W. Gore read a Paper on "Sensation."

Present, 49.

Saturday, July 25th.

B. C. Stilwell read a Paper on "Lighthouses."

Present, 64.

Saturday, October 3rd.

J. T. Speer read a Paper on the "*Times*."

Present, 45.

Saturday, October 31st.

Rev. P. H. Kempthorne read a Paper on "The Cave Men."

Present, 35.

Saturday, November 14th.

Professor Rupert Jones read a Paper on "Silica."

Present, 85.

Saturday, November 28th.

H. D. Pender, Esq., read a Paper on "Torpedoes."

Present, 300.

Saturday, Desember 5th.

Canon Tristram read a Paper on "The Natural History of Palestine."

Present 150.

MINUTES OF MEETINGS.

Saturday, February 21st.

Exhibitions.	*Exhibitors.*
1. Collection of West India Plants, dried	The PRESIDENT.
2. Gold Jacobus	
3. Gold Mohar Rupee, and coins of George III..	NEDHAM.
4. Roots of two Fir Trees fused into one Skin...	F. W. CAULFEILD.
5. Seedling Cedar of Lebanon.................	DAVIDSON mi.
6. Vegetable Tinder and Botanical Specimens from South Africa......................	S. BALL.

The Society then listened to a paper by the Botanical Secretary, on the Charib Indians. Owing to Willett's unfortunate absence, the paper was read by Speer. It was accompanied by specimens of implements, weapons, &c., and was well received. The following is a brief extract:—

"These Charibs are extinct in most of the West Indian Islands, but a settlement of them still remains on the windward coast of St. Vincent. They are round-faced, flat-featured, oblique-eyed, and have long black hair, and are consequently quite distinct from the negro. They are characterised by these two peculiarities, viz.: they are buried sitting, crouched up; and their language, which is fast dying out, is full of repetitions, and is, in part at least, different for the two sexes. The greater part of the island is coral, and as stone for making implements is rare, the Indians were forced to use the next best material, *shell.* These implements vary greatly in shape, such as hatchets, chisels, spear, and arrow heads, and what are most like our spoons. This last kind are, as a rule, always found broken, and only one has been discovered whole. They are supposed to have been considered as part of their owner, and to have been snapped at his death. The implements are found mostly in the neighbourhood of springs, and the popular name for all kinds is 'thunderbolts.'"

Present, 42.

At a private business meeting held after the public meeting, Paget resigned his membership.

Saturday, March 7th.

Exhibitions.	*Exhibitors.*
1. *Gryllo-Talpa vulgaris*	The PRESIDENT.
2. Large nodule of Iron Pyrites, from Seaford, Sussex	POPE.
3. Maunday Money	WILSON.
4. Prince of Wales' Penny, Birmingham Penny, Model of Two Sovereign-pieces (Geo. IV.) &c.	MALLESON.

B. C. STILWELL proceeded to read a paper on "The Channel Passage," illustrated with sketches and diagrams of an elaborate character.

The lecturer began by describing the different methods that were proposed prior to the year 1871. Of these, that proposed by M. Thomé was by far the grandest, who proposed a tunnel that should start from Cape Grisnez and cross to a point midway between Dover and Folkestone: there would be on a mid-channel shoal called the "Varne," where the depth of water at low tide is about twenty feet, a vast construction called the Varne Star. Here there would be a shaft three hundred feet deep, descending through the chalk until it came to the level of the submarine tunnel railway; at the top of the shaft would be four granite quays, where ships would unload, and the cargo would find its way to the bottom, where it would be conveyed by rail either to France or England. The railway was to reach the open air by a tunnel, on the English side three miles long, on the French side eight miles in length. The whole work was estimated to cost £6,500,000.—Mr. J. P. Smith proposed a scheme in 1861 for a gigantic wrought-iron tube to be placed at a level of about twelve yards below the surface, large enough to contain railway trains. It would be kept in position by chains, rods, and masonry piers at a distance of a mile or so apart; the cost was set down at £10,000,000.

He then proceeded to give an account of Mr. Fowler's scheme, deferring Mr. Mackie's and Mr. Bessemer's to another occasion. Mr. Fowler proposed to construct vessels large enough to convey railway trains across, of which the following is a short description:—They would be 450 long, 57 in breadth of beam, and 85 feet wide over the paddle-boxes. The stem and stern would be made capable of opening to admit the entry of the train of railway carriages, assisted by a hydraulic hoist; and these would run upon a railed platform, occupying the whole length of the boat on its main deck, protected from the weather by the upper deck: but the heavy goods trucks would be lowered down an incline into the hold beneath. New harbours would be constructed at Dover and Andrecelles large enough to contain these huge vessels. The practical results of this great railway-ferry link of international communication would be a saving of two miles of water and fourteen miles of railway between London and Paris, and a saving in time of at least two hours. The expenditure for this great work will be about £2,000,000, and the ferry may be in operation in two years from its commencement.

The next scheme he described was that of Captain Dicey. The principal objects which he had in view as necessary to improve the transit were:

(1) To provide ample accommodation for all classes of passengers under shelter, as well as on deck.

(2) To reduce the rolling and pitching of the vessel to a minimum.

(3) To keep the draught of water of the vessel to six feet.

To carry out this last object it was necessary that the vessel should be flat-bottomed, in order to obtain the displacement required. It is well known to those who have been to sea in flat-bottomed vessels that they are the most uncomfortable, because they roll with a jerk even in a moderate swell. Captain Dicey therefore was impressed with the necessity of adopting some mode by which the flat-bottomed vessel would become steady, and having frequently seen the outrigger vessels of the Indian seas riding at anchor in the open roadsteads so steadily that a man could move about on their decks without inconvenience, he was induced to adopt the double form of vessel, which is on the same principle as the outrigger. Arrangements for carrying out this principle on a large scale may be thus described. Imagine a ship 280 feet long and 32 feet beam, flat-bottomed, with 16 feet depth of hold, divided right through from end to end in the direction of her length; and suppose the interior sides of the two halves thus exposed and open to be covered in with iron. These interior sides of the two halves would then be quite flat, and the exterior sides would be of the original form of the ship. Now let the two halves be separated until the interior sides are 28 feet apart from end to end. Then let a continuous bridge of iron girders be made to span, and firmly connect these two halves, the bridge being 200 feet long, leaving 40 feet clear at each end of the vessel. The engines will be placed amidship on each hull, and the paddles, two in number, between the two half ships. The strength of the girders will not have to stand much strain, as the vessel will only draw six feet of water and will carry little cargo, but the vessel is so strongly constructed that if one hull was placed on the pier at Dover, and the other hull was suspended in mid air, it would take 11,500 tons to break the connection between the two hulls. Captain Dicey's vessel is now being constructed at the Thames Iron Shipbuilding Company's yard, and will be launched this summer.

Present, 39.

At a private business meeting of the Society, held after the public meeting, Speer, was elected a member, *vice* Paget, resigned.

Arkwright and Temple were also elected Associates.

A. GREY,
Secretary.

Saturday, March 28th.

Exhibitions.	*Exhibitors.*
1. *Aucupa Japonica* (fruit)	The PRESIDENT.
2. Silver Leaves from South America	WILLETT ma.
3. Whitby Ammonites	HAINES ma.

Mr. CAULFIELD read a paper on "Natural Forms," of which the following is an extract:—

By "natural forms" are here meant the shapes (including mere lines) which we see in everything around us that is not made by the hand of man; and these are considered simply as they appear to us, without regard to scientific accuracy. There is little need to maintain that these forms were given us, not as text-books to be criticised, but as pictures to be delighted in and studied with reverence; and although in matters of taste demonstration is impossible, it seems on moral grounds more fitting that a man should admire the works of God than that he should admire his own; and probably most simple minds feel more pleasure in looking at the outline of a rock or a flower than at any number of scrolls, wreaths, monograms, and such things.

Simple geometrical forms occur sometimes in nature, as *the straight line* in the horizon of the sea, the rays of the sun shining through mist, falling drops of rain, the sides of crystals, &c.

Rectilineal angles and figures are formed by combinations of these same straight lines.

The circle appears in the sun and moon, the rainbow, and the ripples on water when a stone is thrown into it, though this of course is seen from the bank as an *ellipse*.

But when we consider how very few the above-mentioned forms are amongst the innumerable multitude which we see at every glance, we must come to the conclusion that they were meant as striking exceptions to forms of a different character.

The following extract from Ruskin's "Stones of Venice" will serve as a guide in our further inquiry:—

"The lines of nature are alike in all her works, simpler or richer in combination, but the same in character; and when they are taken out of their combinations it is impossible to say from which of her works they have been borrowed, their universal property being that of ever-varying curvature in the most subtle and subdued transitions, with peculiar expressions of motion, elasticity, or dependence."

(This was illustrated by lines—all more or less closely resembling one another—taken from a glacier, a nautilus shell, the branch of a spruced fir, a willow leaf, an eyelid, and the top of a hill.)

Another point to be observed in natural forms is, that they are the results of natural forces, and of forces operating orderly and constantly, never wasting any power, but expending themselves always in the easiest way, and producing the greatest possible effect. No stream ever takes a crooked course if a straight one would offer less resistance, nor *vice versâ*, and so with every natural object without exception; and the result is, the carving out or building up of forms the most graceful, the most powerful, the most expressive.

It follows that natural forms could not, under the present constitution of things, be other than they are. Given a rock of a certain quality in a certain situation; given all the volcanic forces of the earth—the storms, frosts, rain, and sunshine—and its outline is infallibly determined. But this certainty of the operation of natural forces enables us also to reason backwards, and infer the cause from the effect, as well as the effect from the cause. Thus, when we see a rock with its projecting parts rounded, or its surface eaten out into hollows, we think at once of the storms or waves that have been beating against it, and call it weather-beaten; and the history with which we thus invest it is, perhaps, its greatest charm.

All natural forms, then, bear the record of past or the impress of present natural forces; and associations of this kind may possibly cling to the abstract form itself, and be the root of its power of expressing physical and almost moral qualities, and have something to do with the pleasure with which we regard it when we see it under different circumstances or in human art.

Present, 38.

A. GREY,
Secretary.

Saturday, May 23rd.

G. H. Gordon read a paper on "The Solar System," but owing to the unavoidable and unexpected absence of the Secretary, no account of this meeting was preserved.

A. GREY,
Secretary.

Saturday, June 6th.

Exhibitions.	*Exhibitors.*
1. A Rhubarb leaf* of enormous size (formed by the fusion of two leaves into one)..........	The PRESIDENT.
2. Furze Mites	The PRESIDENT.
3. Lace Wing Fly, just emerged from its pupa-case	
4. Bones from a Cromlech in Guernsey	J. L. BEVIR.

Mr. KEMPTHORNE read a paper on "The Ancient Stone Monuments of Avebury," of which the following is a brief extract:—

The ancient remains at Avebury consisted of a large circle of unhewn boulders, surrounded by a rampart. Within this circle, which originally consisted of about 1,000 stones, and measured nearly a quarter of a mile across, were two smaller circles. On the outside, and apparently intended as an approach to the monument, was an avenue, formed of similar boulders, extending for three-quarters of a mile. The tumulus of Silbury Hill, the largest artificial mound in England, is situated about the same distance off, and probably forms part of the group. Among the subordinate members of the group there were still remaining in the reign of Charles II. two dolmens and cromlechs. The stones locally called "Saxon stones," which are employed in the construction of the monument at Avebury, are found lying in great abundance on the surface of the downs. Three principal theories of the purpose to which Avebury and similar monuments were devoted demand attention. The first is that of Dr. Stukeley, an antiquary of the seventeenth century. It is that they were constructed by the Druids, and used as temples. They were also connected with snake-worship. It is pretty certain, however, that the Druids did not worship serpents, and there is no evidence of their connection with the Druids or with snake-worship. The second theory is that they belong to the stone age, and are of immense antiquity. It does not follow, however, that because few remains of metal are found among them they belong to a period previous to the discovery of iron. It is more likely that they were constructed by partially-civilized nations after they had come into contact with the Romans. This theory, which has been put forward with great skill and research by Mr. Fergusson, though not entirely free from difficulties, appears to offer the most rational account of the origin of the stone circles and other monuments. They are unquestionably sepulchral, are probably memorials of battles, and are not anterior to the Christian era.

Present, 52.

A. GREY,
Secretary.

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* This leaf was 3 ft. 6 in. high, and 6½ in. in circumference in the thickest part of the stem. It had two mid-ribs, one 30 in. and the other 30½ in. long, and it weighed 3 lbs. 6 oz.—C. W. P.

Saturday, July 4th.

	Exhibitions.	*Exhibitors.*
1.	*Helix Pomatia* (the Edible Snail)	The PRESIDENT.
2.	Carbonate of Lime, from Wells, in Somersetshire	
3.	*Sirex gigas*	
4.	*Gryllotalpa vulgaris* (the Mole Cricket)	
5.	*Lycosa saccata*	
6.	*Hesperia Actæon* (the Dingy Skipper)	STILWELL.
7.	Slough of Grass Snake	J. L. BEVIR.
8.	Head from Pompeii	
9.	Pod of Cotton Plant	
10.	Cells of Leaf-cutter Bee	W. DAVIDSON.

Present, 45.

J. F. W. GORE read a paper on "Sensation," but the lecturer having preserved no records of his lecture, it is impossible to give any extract from it.

A private business meeting of the Society was held afterwards, and J. L. Bevir asked whether it would be practicable to have field-days of the Society, as was usual with other public schools. The President replied that he would inquire of other societies.

A. GREY.
Secretary.

Saturday, July 25th.

	Exhibitions.	*Exhibitors.*
1.	A large collection of weapons and other curiosities from Australia, Fiji, Solomon Islands, New Zealand, and India	PENDER (O. W.)
2.	Mouse Grass from Malta	BEVIR.
3.	Cumberland Lead	
4.	Lepidoptera new to the list	DAVIDSON.
5.	Photographs of Indian Temples and Scenery near Odeypore, &c.	POLLARD.

Present, 48.

B. C. STILWELL then read a paper on "Lighthouses."

Lighthouses, as I suppose you all know, are by no means of modern invention. The most ancient structure of this description was the Pharos of Alexandria. It was commenced by Ptolemy the Elder, and finished some years after by himself and his son, Ptolemy Philadelphus, in the year of the world 3670, on the island of Pharos, in the bay of Alexandria. It was built on the east end of the island, upon a rock of white marble, of a large square structure, on the top of which fires were kept burning for the direction of vessels. It was a most magnificent tower, 450 feet high, consisting of several storeys and galleries, with a lantern at the top, which could be seen many miles off. The Colossus at Rhodes was another ancient erection for this purpose, regarded as one of the seven wonders of the world. According to popular tradition, it was the statue or figure of a man, dedicated to Apollo, and built in such a manner as to stand astride the entrance of the harbour, that ships might sail between its legs, which were fully 80 feet asunder. A staircase was built up the inside of it, and in the outstretched right hand was a vessel to hold fire, as a landmark and guide to mariners. The entire figure was 105 feet in height, and made of brass. It took twelve years to build, but it only stood fifty-six, being thrown down by an earthquake, in which state it remained until 674 A.D., when the metal was melted down and sold by the Saracens. The Romans built a large number of lighthouses after the model of the one at Alexandria, but few of these now remain to us. There is one standing within the walls of Dover Castle, of which I will pass round some illustrations; and if you turn to the beginning of the book, you will see by the picture that there were originally two at Dover; but the one near the Castle is the only one that is perfect; of the other, the foundations alone remain. These lights must have been very useful to the Romans when navigating the Straits. Many a dark night, whether making for the Dover inlet, or afraid of hugging the South Foreland too close, or a passage to Richborough, one can fancy a Roman watch looking out for the Dubrian lights (as an old salt of ours would say) " with tears in his eyes." On the other side of the Channel, too, there was a tower at Boulogne, built by Caius Caligula, to commemorate his victory on the ocean. The height of the beacon above the ground line was 124 feet, rising in twelve stages. gradually diminishing from the base to the summit. From a very early date it had been called " La Tour d'Odre," by which name, among the Boulonnais, and by the more familiar term of " The Old Man " among the English sailors, it continued to be well known as a beacon light of the coast until the gaining of the sea upon the cliff destroyed it in 1644.

Of modern lighthouses, the two of chief celebrity, and probably of most ingenious construction, are that on the Eddystone and the Bell rocks. The Eddystone rocks consist of several ridges, bearing the particular names of the "House Reef," the " Sugar Loaf," the "North Rock," &c. The House Reef is not the most considerable of the reefs, but it contains the boldest rock of all the groups. The first attempt to raise a lighthouse was made by Mr. Winstanley, in 1696. It consisted of a dodecagonal stone tower, rising 44 feet above the highest point of the rock and 24 feet in diameter. At the summit there was a balustrade and a platform, from which rose eight pillars supporting a dome of the same diameter as the tower. Above the dome was a second octagonal tower, 15 feet in diameter and 7 in height, and over this was fixed the lantern containing the lights. It took four years to build, and the light was first exhibited on November 14th, 1698. The edifice remained unharmed till 1703, in which year the builder having visited it to superintend some repairs, expressed such confidence in its strength, that he wished he might be shut up in it during the most violent storm which ever blew under heaven. His desire was too fully gratified. A hurricane arose on the 26th of November, and on the following morning not a vestige of the lighthouse remained, excepting some of the irons which cramped it to the rock and a portion of the surrounding chain which had been driven into a cleft. In July, 1706, a second lighthouse was commenced by Mr. Rudyerd, a London silk merchant, who appears to have possessed great mechanical skill. The following is his own description of it:—A conical fixture of wood was formed of seventy-one upright beams bolted to circular ribs of wood inside, upon which the floors were placed. The diameter of the base was 23 feet, the top 15 feet, the height 62 feet. For 19 feet from the lower part of the rock this immense wooden barrel was filled with three beds of moorstone, with strong floorings of timber between each bed. In 1709 the work was completed, and although in 1723 and 1744 some extensive repairs were needed, this admirable building for forty-nine years defied the fury of the waves, unhappily to perish by a not less dangerous element. On the night of the 2nd of December, 1755, the lantern was discovered to be in flames, and the fire communicating to the timbers burnt downwards. Chased successively from room to room, the wretched inhabitants at last found refuge in a cavity of the rock. One of them, while looking up at the cupola of the lantern, was covered with a shower of molten lead, some of which he declared passed into his stomach. The assertion was discredited, but the man having died twelve days afterwards, more than seven ounces of lead was found in his stomach.

At the time at which Smeaton undertook the erection of a new lighthouse on the Eddystone, there existed in the minds of the proprietors certain prejudices in favour of Rudyerd's building. The safety of the building, it was urged by some, had in a great measure depended on the elasticity of the materials, which enabled it to yield to the shocks of the sea. But Smeaton thought that the structure wanted weight rather than elasticity. and it was on this early stage of the enquiry that he remarked, "If the building will not give way to the sea, the sea must give way to the building." He sought among the objects of Nature for a quality, capable of supporting its own weight, of resisting the action of the wind and sea, and in the form of the oak he found all the elements he required. The branches covered with foliage, when acted upon by the full fury of a storm, must produce enormous effects on the trunk. Yet partly by its elasticity, partly by the strength resulting from its figure, it resists them all, and falls only at last by gradual and slow decay. But supposing the external figure of such a building to have been determined, and all its dimensions and parts happily proportioned to the limited surface of the rock on which it is to stand, how, inquires Smeaton, can its parts be so firmly bound to the rock and to each other as to enable it to resist the great violence of the sea? In this stage of the inquiry Smeaton fortunately turned his eye on the carpenter's dovetail; to apply the principle of dovetailing in all its generality to a structure like that under our consideration, was in every part a new and untried problem. Much labour must have been bestowed by Smeaton before the system of dovetailing which he finally adopted was made so complete as to enable him with confidence to say that the strength of his building was in every part proportioned to the stress it had to bear; for, as it was eternally rung in his ears from all quarters, that a building of stone would never be found to stand, so did he become additionally anxious to unite all its parts together, that no man should be able to tell at what part it would be overset. You will be able to understand how Smeaton applied the system of dovetailing, by referring to pp. 2 and 3 on sheet 1. (Here the diagrams were exhibited.)

To prevent the horizontal action Smeaton employed joggles; a partial application of this system was made to the fifth and sixth segments of the base, but the first perfect development of it was applied to the sixth and seventh courses. In the first place, the upper surface of the sixth course had a hole of a foot square cut through the stone occupying the centre, and also eight depressions of a foot square and eight inches deep, disposed at regular intervals around it. Into these latter blocks of marble are introduced, one-half of their bulks projecting over the surface of the course. Into the central square, a marble plug of a foot square and twenty-two inches long was set with mortar, and firmly fixed with thin wedges. This plug rose nine inches above the course. The central stone of the seventh course having a proper hole through its middle, was then placed upon the projecting plug and being imbedded in mortar, was in a like manner wedged in, and each side of the plug, and every remaining cavity filled with grout. Under these circumstances, no force of the sea, less than the power capable of cutting the marble plug in two, could move the stone from its place, and it was fixed down by the nail to prevent the possibility of its being lifted. The system I have endeavoured to describe as adopted by Smeaton on the first horizontal course, was continued to the fourteenth, to complete what he denominates the "fundamental solid," diminishing only each course in its magnitude, so as to preserve the external figure of the building. It was necessary, however, on laying these courses on one another to break all the joints, whether it were those which relate to the ends of the stones, or to the dovetailed surfaces to which they owe all their strength. This he readily accomplished, by placing the central block, so that its angles might be turned some degrees from the course below, and which necessarily caused all the joints of the courses to be wider. The walls to be raised above the solid part of the building, though above the average height of the heavy stroke of the sea, yet required, from their limited thickness, every possible precaution. Single blocks only could be employed, and the fickle nature of the granite, joined to the limited thickness of the stones, opposed the application of dovetailing. Guided, probably, by the number of stones adopted on the outside of the first perfect horizontal course, and in order to preserve uniformity in the joining, he was led to fix on sixteen, as the number of stones to compose his wall. Besides other ingenious contrivances, marble joggles, about the size of a common brick, were introduced in the middle of each stone, one half the depth of each joggle being above the course in which it was inserted; each joggle, therefore, when the next course was laid down became connected with the extremities of two stones by the successive breakings of the joints, and hence all the pieces constituting a course, became not only united to each other by means of the clamps at their extremities, but were prevented from moving from the course below by the joggles, thus securing in the whole circuit of the building thirty-two points of support. After the completion of the building it became, of course, an object of interest both with Smeaton and others to discover what effect a violent storm would have on it.

The year 1762 produced a tempest of so tremendous a character as to make one of the opponents of the building assert, "that if the Eddystone Lighthouse survived, it would stand till the day of judgment." The following account of the effect produced upon the lighthouse by this storm was written to Smeaton himself by Dr. Mudge. He says, after describing the sensation felt by the keepers of the light, "that the only damage done was, that the ladder was carried away, and some small matter, as putty, which was cracked by the last summer's heat, was washed off from the lantern; while over 80,000*l*. worth of damage was done in Plymouth Harbour and Sound." The next lighthouse I shall describe is the one situated on the Bell Rock. The Bell Rock differs materially from that on which the Eddystone Lighthouse was built, both as to quality and form. The Eddystone rock is of limited dimensions, and the higher edge of it is never covered by the tide. The Bell Rock, on the other hand, is comparatively one of considerable extent, rising but little above low water mark, and completely submerged at every return of the tide; being composed, too, of the old red sandstone, the sea exercises considerable influence upon it. In the external figure and in the general method of dovetailing, Rennie, who undertook to build the lighthouse on the rock, had the model of Smeaton to follow; but he proposed to apply the one to a new purpose, and to improve the other by some new combination. He extended the base, and imparted a greater degree of concavity to the beautiful curve assigned to the external figure by Smeaton, so that the impulse of the waves on the structure was diminished, and the action on the rock itself rendered easier, and when the waves broke upon the building they would spend their fury on the lighthouse base instead of on the rock itself. In the solid part of the building to the top of the staircase stones were employed of a less length on the outside of the building, but deeper in the direction of the radius of the lighthouse, than had been adopted in the Eddystone, thereby imparting additional strength to a most important part of the structure. But the greatest improvement effected by Rennie was in the floors; in the Eddystone they were virtually domes, which exercised a great lateral thrust upon the walls. Rennie, however, resolved to adopt a large central block, and by a peculiar system of stones radiatory from it to remove all tendency to lateral pressure, and thus to connect all the various acting forces into one particular kind. To understand this system of radiatory stones, it is to be observed that the central block had eight dovetails formed at equal intervals in its edge, to receive the ends of eight other stones, whose outer extremities were to rest on the walls. Now the edge of these stones, from the circumference of the central block, were not entirely straight, but so cut near the block as to form a series of dovetails, to receive an intermediate series of radial stones, resting in like manner on their outer extremities on the walls. Eight of these stones, therefore, were connected immediately with the central block, while the remaining eight derived their attachment from the others. All these stones rested on horizontal beds upon the walls, and thus exerted only a perpendicular pressure upon them, and, in order that the connection with the surrounding wall might be more perfect, a succession of circular stones were added. This important edifice was begun in August 1807, and on the 1st of February 1811, the light was for the first time exhibited. Having described the two most remarkable edifices of this kind in existence, I shall proceed to a few particulars about the lighting of these houses. An engineer has not completed his arduous task when he has successfully raised one of these towers. Another and a very different subject must now occupy his attention—without light an edifice of this nature would be useless. The art of the civil engineer at the time of the erection of the Eddystone was far in advance of that of the optician; at the period when this noble structure came from the hands of Smeaton, such was the limited condition of practical optics that only tallow candles were employed to give it light, unaided, too, by reflectors or any kind of apparatus for concentrating their powers. For more than half a century this feeble light was all that directed the mariner in the very high road of commerce. So recently as the latter part of the last century the sea-lights of Britain consisted of open coal fires; but this imperfect method of illumination was replaced by reflectors having lamps in their foci. · At first these instruments consisted of small faceti of mirror fixed in a mould by means of cement; but reflectors of copper-plate, faced with polished silver, were afterwards introduced. The parabolic form is the most correct for reflecting, the light proceeding from the focus, and falling upon its surface into one beam of parallel rays. When a series of such reflectors are arranged close to each other, raised in a lighthouse, they illuminate constantly, though not with equal intensity, the whole horizon. If, for the purpose of distinction, it is desired to show a revolving light, then several of these reflectors are placed with their axes parallel to each other, on each of the faces of a four-sided frame, which is made to revolve. In such a case the mariner sees a light only at those times when one of the faces of the frame is directed towards him. The flashing light, which is one of the most striking of all the distinctions, was first introduced by Robert Stevenson, the engineer of the Northern Lighthouses, in 1822, at Buchanan in Aberdeenshire. The same engineer also introduced what he has called the intermittent light, by which a stationary frame is instantaneously eclipsed, and is again as suddenly revealed to view by the vertical movement of opaque cylinders in front of the reflectors. The intermittent is distinguished from the revolving light by the suddenness of the appearance and of the eclipses.

Another method of leading the diverging rays proceeding from a lamp into such directions as shall be useful to the mariner, is that of refraction. Fresnel and Brewster hit upon this plan both about the same time. A section of Brewster's lamp is exhibited in fig. 14, Sheet II, where f is the lamp a source of light, the rays of which it is required to throw into one parallel beam. More than one-half of the sphere of light radiating from the lamp, viz., O C A B D E, is intercepted by lenses AB, AC, CB, BD, DE. The cone of rays incident upon the lens AB fall diverging on the larger lens LL, and are refracted into a parallel beam of light. You will be easily able to understand how the other cones are refracted by reference to the figure, so I will not stop to describe it. The method of uniting two or more lenses will be understood from fig. 15, which, if the number of large lenses is only two, will be a horizontal section of the apparatus; but if the larger lenses are four, six, or eight in number, it will become a vertical section. In this manner, by increasing the number of lenses, we may, by means of a powerful lamp, throw any number of parallel columns of light into a horizontal plane and increase the width of these lenses, by employing small lenses and mirrors to reflect horizontally the light that would otherwise be cast into the sea or dispersed in the atmosphere. In Fresnel's first invention a great many of the rays were uselessly expended: some passed upwards to the clouds, and some merely illuminated the floor of the lighthouse: and in order to render these effective, Fresnel ultimately adopted the use of what has been called the internal or total reflection of glass; and here it is necessary to explain, that one of the great advantages of the action by glass over the reflection by metal is the smaller quantity of light that it absorbs. It has been ascertained that there is almost a gain of one-fourth by employing glass prisms instead of metallic reflectors for lighthouse illumination. Fresnel introduced, above and below the cylindric hoop, certain separate glass prisms of triangular section, the first surface of each of which refracted, to a certain extent, any ray of light that fell upon it, while the second surface was placed at such an angle as to reflect, by what is called internal or total refraction, the ray which had before been refracted by the first surface; and the last outer surface produced another refraction, which made the rays pass out parallel with those refracted by the central cylindric hoop. The light falling above the cylindric hoop was thus bent downwards, and that falling below was bent upwards, so as to be made horizontal and parallel to that proceeding from the hoop. Fig. 7 on Sheet II, represents in section this, which is the most perfect of Fresnel's inventions in lighthouse illumination, and when made of the rhomboidal form, and in connection with the diagonal framing introduced by Mr. Alan Stevenson, it may be said to be a perfect apparatus. From what has been stated, it will be readily seen that, so far as regards fixed lights, the dioptric light of Fresnel is a perfect instrument. But the case is otherwise as regards revolving lights, or those where the whole rays have to be concentrated into one or more beams of parallel rays. To revert to the parabolic reflector, it must be obvious that every ray which escapes past the lenses of the reflector never reaches the eye of the mariner, while, if we return to the dioptric revolving light of Fresnel, we find that those rays which escape past the lens are acted on by two agents, both of which cause loss of light by absorption. In order to avoid this loss of light, Thomas Stevenson proposed in 1849 to introduce an arrangement by which the use of one of these agents is avoided and the employment of total reflection, which had been successfully introduced by Fresnel for fixed lights, was used for revolving lights also. This effect may be produced by the combination of an annular lens with a parabolic conoid and a portion of a spherical mirror. This method is employed for a metallic holophote; but where total reflection, as the most perfect system of illumination, is adopted, the front half of the rays is operated upon by totally reflecting prisms, similar on section to those applied by Fresnel to fixed lights, but instead of being curvilinear in the horizontal plane only, they are also curvilinear on the vertical plane, and then produce, on union with an annular lens, a beam of parallel rays similar to what is effected by the parabolic mirror. The rays proceeding backwards fell upon prisms, "ab, ab," which produce two total reflections upon each ray, and cause it to pass each through the flame, so as alternately to fall in the proper direction on the dioptric holophote, so that the whole of the light proceeding from the flame is thus ultimately parallelised by means of the smallest number and the best kind of optical agents. It is a remarkable property of the spherical mirror "ab" that no ray passes through it, so that an observer standing behind the instrument perceives no light, though there is nothing between him and the flame but a screen of transparent glass. At Stornoway bay the position of a sunken reef has been sufficiently indicated by means of a beam of parallel rays thrown from the shore upon certain optical apparatus fixed on the top of a beacon erected upon the rock itself. By means of this plan the expense of erecting a lighthouse on the rock itself has been saved. It has been called an apparent light from its appearing to proceed from a flame on the rock, while the light in reality proceeds from the shore about 650 feet distant, and is refracted by glass prisms placed on the beacon. The descriptions which have already been given have all had reference to the best means of employing a given light. Many attempts have from time to time been made to increase the power of the radiant itself, such as combustion of the lime ball, when exposed to a flow of oxygen and hydrogen gas. When this is placed in the focus of a parabola, as proposed by Lieut. Drummond, a very intense beam of parallel rays is produced. The difficulty of maintaining continuous combustion has hitherto prevented its adoption in lighthouses, although recent improvement have rendered this more feasible than formerly. Colza oil is employed in most lighthouses in Great Britain, and the quantity annually consumed by the Northern lighthouses may be stated at forty gallons for an Argand one inch in diameter, and eight hundred gallons for the 4-inch burner which is used in dioptric lights of the first order. The South Foreland lighthouse, and I believe one or two others, are illuminated by the magneto-electric machine. Very powerful effects can be obtained from such machines of large size driven rapidly. These machines were first suggested by Professor Nollet, of Brussels, and they have been constructed by Helmer, of London. By means of them the electric light is maintained in lighthouses.

The figure which spans round represents the pattern adopted by the French Company. It has eight rows of compound horseshoe magnets fixed symmetrically round an iron frame. They are so arranged that opposite sides always succeed one another, both in each row and in each circular set. There are seven of these circular sets, with, of course, six intervening spaces. Six bronze wheels, mounted on one central axis, revolve in these intervening spaces. Six bronze wheels, mounted on one central axis, revolve in these intervals, the axis being driven by steam power transmitted by a pully and lift. The speed of the rotation is about 550 revolutions of the axis per minute. Each of the six bronze wheels carries at its circumference sixteen coils, corresponding to the number of poles in each circular set. The core of each coil is a cleft tube of soft iron, this form having been found peculiarly favourable to demagnetization. Each core has its magnetism reversed sixteen times on each revolution by the influence of the sixteen successive pair of poles between which it passes, and the same number of currents in alternately opposite directions are generated in the coils. The coils can be connected in different ways, according as great electromotive force or small resistance is required. The positive ends are connected with the axis of the machine, which then sever in the positive electrode, and a concentric cylinder, well insulated from it, is employed as a negative electrode. When the machine is employed for the production of the electric light, the currents may be transmitted to the carbon parts on alternate directions, as they are produced. The driving paces for lighthouse purposes is about three large paces. The lighthouses of Great Britain are managed by the three following Boards:—The English by the Trinity House of London; the Scotch by the Commissioners of Northern Lights; the Irish by the Ballast Board of Dublin. The Merchant Shipping Act of 1854 provides that the Scotch and Irish Boards shall receive the sanction of the Trinity House before the erection of new lights, while all three must receive the sanction of the Board of Trade both as to new lights and the expenditure of their funds, the source of which is a passing toll on shipping.

The lecturer then exhibited some photographs of lighthouses, kindly lent by Sir G. Temple, and a vote of thanks to him was proposed and carried unanimously.

A private meeting was then held for the transaction of business. The following officers were elected for the ensuing year:

President ..	..	..	Rev. C. W. Penny.
Secretary	..	..	M. D. Malleson.
Treasurer	..	..	B. C. Stilwell.
Botanical Album Keeper			E. W. Willett.
Entomological	do.	..	J. L. Bevir.
Geological	do.	..	J. T. Speer.
Zoological	do.	..	J. F. W. Gore.

H. D. Pender (O. W.), was elected an Honorary Member of the Society; and Allen ma. and Pollard were elected Corresponding Members. A vote of thanks was passed unanimously to the retiring officers, especially to the President, the Rev. C. W. Penny. The proceedings were then brought to a close.

M. D. MALLESON,
Secretary.

Monday, September 28th.

This was merely a private meeting of the Society for the transaction of business.

The following were elected:—Honorary Members.—J. Niven, Esq., S. G. Tremenheere, Esq. Member.—Davidson mi. Associates.—Hancock, Jones ma., Strachey, Jones mi., Layard mi., Bunny.

M. D. MALLESON,
Secretary.

Saturday, October 3rd.

Exhibitions.	*Exhibitors.*
1. Fruit of an Apple grafted on a Plum stock...	E. W. Willett.
2. Ammonite	J. L. Bevir.
3. Japanese Studs with Insects in Mosaic	H. J. Du Cane.
4. Burying and other Beetles	The President.
5. Three Apollo Butterflies caught in Switzerland	J. L. Bevir.
6. A piece of an Elephant's Tooth, showing the effect of toothache upon that animal........	H. J. Du Cane.

Present, 45.

J. T. **Speer** then proceeded to read a paper on the *Times.*

The *Times*, as I suppose you know, is one of the largest and the most important daily newspapers in England—one may say in the world. It was founded towards the end of the last century by Mr. John Walter, a London printer, its first name having been the *Daily Universal Register*. Till 1803 the *Times* was comparatively unknown; but in that year a son of Mr. Walter became joint proprietor and sole manager, and, under his guidance, the *Times* soon became remarkable for the freshness and accuracy of its news, and the independence with which it espoused opinions on social and political questions. In 1808 the *Times* made an attack on Lord Melville's administration at the Admiralty, and the Walter family were in consequence deprived of the lucrative post of printers to the Board of Customs, which they had held for eighteen years. As there was at that time a great demand for continental news in consequence of the war, the *Times* had established correspondents abroad. Their letters were transmitted through the regular channels, but the packets were stopped by Government, and Mr. Walter was informed that he would be supplied as a favour with official information. He declined to avail himself of this offer, and it was then that he took means to secure the special and early transmission of news for his paper. His success was remarkable; and on many occasions the public despatches were anticipated. Thus the *Times* announced the capitulation of Flushing two days, and the result of the battle of Waterloo some hours, before the arrival of the regular despatches. An increased circulation was the reward of these efforts, and the only limit to the further increase of circulation was the impossibility of throwing off a sufficient number of copies of the paper by the hand printing-press. Mr. Walter then saw the importance of introducing steam-printing; and as early as 1804 he had encouraged an ingenious inventor of the name of Martyn to complete a machine he had invented; but Mr. Walter, the elder, who was then alive, had been less sanguine than his son, and the idea had fallen to the ground. Some years later, however, Friedrich König, a German, invented and patented a new press which could be worked by the steam-engine, and Mr. Walter became his patron. He gave him, in 1814, an order for two machines, which—in anticipation of opposition on the part of the pressmen—were put up in premises adjoining the office. On November 29th, in the same year, it was announced to these men that the paper had been printed by steam, and that there was no further occasion for their services. It is very creditable to the proprietors of the *Times* that no advantage was taken of the violent language used by the workmen on this occasion, and that their wages continued to be paid while they remained without employment. Under the old mode of going to press about 280 copies could be printed per hour; but with the new machine it was possible to take 1,100 impressions in the same time, so that the *Times* had a means of increasing its circulation not at the command of the other newspapers.

From this time Mr. Walter entrusted the superintendence of the literary department of the paper to Mr. Thomas Barnes, the first editor. Mr. Barnes wrote few articles, but he fixed on the subjects to be discussed, and displayed great ability in giving uniformity of tone and point to the articles passing through his hands. It was during his editorship that a series of "leaders" by Mr. Edward Stirling obtained for the paper new political and social influence, recognized by the name then applied to it of "The Thunderer." It was in this time, too, that O'Connell attacked the accuracy of the *Times*' reports of the Parliamentary debates, and was signally defeated by the testimony of those whose speeches were said to have been tampered with. In 1841 Mr. John Delane succeeded Mr. Barnes as editor of the *Times*, and he has continued since to conduct the paper with no less ability than his predecessor had done. In the same year, the newspaper which had always sought to obtain accurate commercial intelligence won a new title to the confidence of the mercantile community by the detection of a great scheme to defraud the leading banking-houses of London and other cities. If Mr. O'Reilly, the Paris correspondent, had not discovered the conspiracy, which was headed by a French Baron and other persons of distinction, it was shown that the leading banks would have been defrauded to the extent of one million sterling!

The *Times* did not altogether escape punishment. It had to defend an action at law, in which, although a verdict for one farthing damages was given, the defendants had to pay their own costs. To relieve them of this burden, £2,700 was soon subscribed by the bankers and merchants, chiefly of London. The offer of this sum was declined, and it was, in consequence, employed to commemorate the event which had led to its being collected. Two sums of £1,000 each were devoted to the foundation of *Times*' scholarships at Oxford and Cambridge in connection with Christ's Hospital and the City of London School; and the balance was employed to erect marble tablets at the *Times* office and Royal Exchange, recording the obligations the mercantile community was under to the proprietor for the generous manner in which their interests had been protected. After the death of Mr. Barnes, Mr. Walter did not relax his efforts to obtain early intelligence. In 1842 a remarkable instance of the trouble and expense he incurred with this view was brought under public notice. The news of the massacre in the Cabul Pass was first made known in the *Times*. The correspondent's letter containing it had been forwarded from Marseilles to Paris by carriages specially hired, from Paris to Boulogne by horse, and thence to Dover by the steamer belonging to the newspaper, which had been for days in the Channel with the steam up, and from Dover to London again by horse. The letter reached the *Times* office at 2 P.M. on Sunday, and was immediately put in the hands of the compositors, who had been kept in attendance from the preceding day expecting its arrival. The only news of the event which had reached England at the House of Commons next day was that contained in the *Times*. The expenses of the transmission amounted to £300.

The *Times* again became an object of public notice by the publication of Mr. W. H. Russell's letters from the Crimea in 1854, India in 1857, and America in 1861. The prosperity of the paper continues unabated, from the excellence of the leading articles, the accuracy of the reports, and other reasons.

As my Paper is rather short, I will supplement it by an account of the formation and use of the types.

"Type" is the name given to the stamps or dies which impress the letters on the paper in printing. The first step in the process is the cutting of a punch or die resembling the required letter. The punch is of hardened steel, with the figure of the letter cut the reverse way upon its point. On this die being finished, it is struck into a piece of copper about 1¼ inch long, ⅛ inch deep, and of a width proportionate to the size of the type to be cast. This copper being so impressed with the representation of the letter, requires to be adjusted to the mould, so that the face or impression of the punch (in the copper) may be brought into such relation with the metal which forms the body or stalk of the type, that when the types are "set up" they may stand at the proper distance from each other, and be in "line," or range, and also square to the page. This work is termed "justifying," and the copper is now called a "matrix." The matrix is now fixed into a small instrument or frame, called the "mould," which is composed of two parts. The external surface is of wood, the internal of steel. At the top is a shelving orifice, into which the metal is poured. The space within is of the size of the required body of the letter, and is made exceedingly true. The melted metal being poured into this space, sinks down to the bottom into the matrix, and, instantly cooling, the mould is then opened and the type is cast out by the workman.

Type metal was a compound of lead and regulus of antimony, with a small proportion of tin; but in 1856, a new compound was formed by adding a *large* proportion of tin to the lead and antimony, which considerably increased the cost of the metal while it doubled its durability. The proper proportions of these metals are regulated by the size of the type, a greater quantity of art being employed for small than large letters. Various attempts were made during the early part of this century to cast type by machinery, but the first successful machine was introduced and patented by Miller and Richards, of Edinburgh, in

1848. This machine, which requires a man to drive it, produces more than double the quantity that the hand-mould did, while the finish and regularity of the type so cast are much more perfect. Another machine was constructed and patented some years later by the same firm, with the view to apply steam for driving, which was successfully completed in 1868 and is now the most advanced and approved system of casting.

The President, having moved a vote of thanks, which was carried unanimously, then explained the method now in vogue of printing by means of stereotype; and stated that he thought the most marvellous thing was the rapidity with which the requisite number of copies was dealt out to the various dealers.

The public meeting having then been dissolved, a private business meeting of the Society was held, and the following were elected:—Member: Fitzherbert. Associates: Bostock, Davies iii. Some slight alteration was also made in the rules of the Society, and the meeting then dispersed.

M. D. MALLESON,
Secretary.

Saturday, October 17*th.*

Notice was given to the effect that the Secretary would read a paper on "Spiritualism," but the reading of the paper, for unavoidable reasons, was indefinitely postponed.

M. D. MALLESON,
Secretary.

Saturday, October 31*st.*

Owing to the unavoidable absence of the President, the Rev. P. H. Kempthorne took the chair.

Present, 35.

Exhibitions.	*Exhibitors.*
1. Norwegian Belt	J. L. Bevir.
2. A specimen taken out of a grate, supposed to be melted flint-glass	

The Secretary having been voted to the chair, the Rev.

P. H. Kempthorne then read a paper on "The Cave Men," of which the following is a short extract:—

About four miles from Weston Junction, in Somersetshire, is situated Banwell Cave. This cave is the first of a remarkable series of caves, of which there are many in that part of the country. Having reached the entrance, after a somewhat rough cross country walk, we were shown the entrance by the gardener's wife. It was lighted by tallow candles, so that at first I could not see much of the cave. It is a single chamber, with an arched roof of considerable size and about twelve feet high. Water was dripping everywhere from the roof, although it was a dry summer, and a little stream was running down the further end; and we could see where the floor had been undisturbed—it was composed of the very hard and semi-transparent substance known as stalagmite. In some cases this stalagmite is formed into fantastic pillars beneath, while in other cases it hangs in pendants from the roof, in which case it is called stalactite. At the side of the cave bones were piled up to the height of four feet or so by those who first dug them out from the floor. On examination many of them are found to belong to animals never known to exist in England in historical times, some of which could not possibly live in our present climate, and some of a species which are found nowhere in the world; time would fail to give a detailed account of them. The next cave is Kents, near Torquay, where many remains of man's handiwork have been discovered. The deposits in this cave are as follows:—

1. Large blocks of limestone from roof, sometimes cemented with stalagmite.
2. Black muddy mould, three to twelve inches thick, containing relics of different periods, such as Roman pottery, marine shells, bronze, knives, and various mammalia.
3. Stalagmite of one to three feet thick and almost continuous.
4. Band of black earth like No. 2.
5. Red cave earth, containing fragments of limestone, implements, and bones of extinct animals.

The flint implements here discovered were apparently used for scraping some hard substance, being often blunted at the edges. There are also found harpoon heads, a curious kind of pin, and some needles 1 inch to 3¼ inches long, probably made from reindeer sinews. Bones of the following animals are also found:—Cave lion, cave bear, woolly rhinoceros, beaver, Irish elk, cave hyæna, and many others, notably the sabre-toothed tiger. From comparison of the flint implements found here with those of the French caves, as well as from its enormous depth, there seems reason to believe that the filling in with cave earth was the work of a long time, the whole bottom being covered with it to some depth. The black band in which numerous pieces of charcoal occur seems to indicate a more continuous occupancy than the red earth. There are two classes of evidence bearing on the probable antiquity of these human bones which are found there.

1. The time required for so many carnivorous animals to become extinct.

2. The great number of centuries to allow for the great changes of physical geography. All these relics point back to a time when man shared Europe with the mammoth and hippopotamus; a time which will well repay any interest which may be taken in it.

After questions had been asked by J. L. Bevir, W. Davidson and R. H. W. Hughes, F. Caulfeild, Esq., addressed the meeting. He said that the growth of stalagmite was remarkably slow, as in the cave in Devonshire, there is not less than an inch separating the stalagmite and stalactite, and a single drop of water will fill up that space ; nevertheless, during the thirty years that the cave has been known, no perceptible difference has been made, though water has been dropping all the time.

The Rev. P. H. Kempthorne then resumed the chair, and the public meeting having been adjourned, a private meeting of the Society was held.

Mr. Ilbert was elected an honorary member.

W. Davidson asked the President what had been done in the matter of field days.

The President being absent, the Secretary informed the honourable member that the President was taking the matter into consideration.

The Secretary having informed the Society that Professor Rupert Jones had kindly consented to read a paper at the next meeting of the Society, the meeting then dispersed.

M. D. MALLESON,
Secretary.

Saturday, November 14*th.*

Professor Rupert Jones gave a lecture on "flint, agate, jasper, and other kinds of silica," of which the following is a brief analysis :—

The mineral which goes by the name of silica is very important, inasmuch as it is a component in two-thirds of the whole surface of the earth. In flint we find silica; in sand it is an ingredient to a very large extent; quartz and granite are chiefly formed by it. Since, then, it forms so important an item in the composition of the earth on which we live, we ought to know what silica is. The name is nothing; it is merely used to classify, just as we talk of John Smith merely in order to distinguish him from all other Smiths. Well, then, silica is a compound of oxygen and silicium, a metallic body which was discovered by Sir Humphry Davy. It cannot be kept by itself, because it unites itself immediately with any body with which it may happen to be brought in contact. The form in which it is found is, in most cases, that which is known as the *Bipyramidical Dodecahedron;* although the pyramids are sometimes single, not double, as the name implies, and sometimes are separated by prisms.

As quartz is a mineral in whose composition silica plays a very important part, let us now turn to consider its qualities. Its hardness is considerable, it being, as will be seen, fourth on the following list, which denotes the relative hardness of minerals :—

Diamond.
Sapphire.
Topaz.
Quartz.
Felspar
Fluorspar.
Chalcite.
Mica.
Gypsum.
Rocksalt.
Talc.

Any one of these minerals will scratch any other which may be below it on the above list; thus diamond will scratch quartz, and quartz mica.

Quartz also has the power of resisting acids, which have the power of dissolving most bodies. It frequently occurs in crystals which consist of fine particles of silica, which are brought together and deposited by the action of water. Of quartz crystals are frequently manufactured those spectacle lenses which go by the name of pebbles. Gold is frequently found in quartz, notably in the diggings of Australia and California. It finds its way there by the action of water. Again, it is washed down by the water and deposited along with the quartz sand; so also platinum, zincstone, and diamonds are frequently mingled with the quartz sand.

Silica occurs again in many other hard minerals, whose principal use is for ornaments, such as cornelian, which was originally some form of agate, but has since been exposed to the sun and changed, and which, too, forms the relics of old volcanic rocks which have been split up and destroyed, and jasper, which is another form of clay, and is not valuable in itself, but becomes so when polished. This (here a specimen was handed round) is a jasper pebble from South Africa, in which you will notice many ridges and undulations. These were caused by lateral pressure of the earth, for the jasper, being originally clay, was jammed among the hard rocks and crumpled up into the shape it now is. Bloodstone is another form of silica; it is better known under the name of green serpentine, but it is useless for any permanent ornament, since it is not hard enough to resist scratching. Limestone, too, is made up to a great extent of silica. The form of silica might be compared to that of sugarcandy on a string, the crystals being somewhat of the same shape."

The President then moved, on behalf of the meeting, a vote of thanks to Professor Jones for his great kindness in having come over to lecture from Sandhurst, a kindness which had often been put to the proof before, and never been found wanting.

The vote of thanks was carried with acclamation.

Present, 85.

M. D. MALLESON,
Secretary.

Saturday, November 28th.

There were no exhibitions.

Present, about 300.

This meeting was held in the great School, it being correctly anticipated that the drawing school would be inadequate to contain the number present.

H. Pender (O.W.) read a paper on Torpedoes :—

"In naming the subject which I propose to offer to your attention to-night, it occurs to me that you may think it too foreign to the objects which this society was organized to consider. I believe, however, that now as formerly the Natural Science Society is sufficiently comprehensive in its views to admit of the discussion of torpedoes; inasmuch as the subject of coast defence is one which is now engrossing more than ever the attention of scientific men, and I believe that in the future we shall look to the torpedo as one of our most powerful engines in defensive warfare.

It is not possible in one evening thoroughly to exhaust such a subject as the one we are now dealing with; I must therefore warn you that although there are many points of interest which time will not permit me to touch upon, at the same time I shall try and not pass over any of the more important features. If I do not succeed in making myself perfectly clear, I must claim your indulgence until the paper is finished; after which I shall be most happy to answer any questions and give any further information as far as lies in my power.

To the Chinese, I believe, belongs the merit of having invented the torpedo, but like many other of their inventions they do not seem to have turned it to much account. I remember seeing, some years back, a model of a Chinese torpedo, which consisted of a strong wooden case containing the charge; this was submerged to the depth of about a fathom and a half, and from the case a tube—probably of bamboo—reached to within a few inches of the surface. The upper end of this tube was fitted with a plug which the operator on shore could remove at pleasure by means of a long line fastened to it; on pulling out the plug the water rushed down the tube, and by its weight acted on a match-lock. I do not pretend to vouch for great accuracy in this description, as it must be quite ten years since I saw the model.

About the year 1775 an American named Bushnell produced what was probably the origin of the modern torpedo: he was also the inventor of a submarine or plunging boat for attaching shells to ships' sides while submerged. Bushnell was very troublesome to us during the war of independence, and succeeded in blowing up several small craft. About Christmas, 1777, he cast a number of his torpedoes, which it seems were shaped like kegs, adrift in Philadelphia harbour, intending to destroy the British shipping. But it seems that on the very night of his attempt all the vessels had been taken into dock to escape the ice. The English crews, however, got wind of something and manned all the ships and wharves, keeping up a hot fire on the torpedoes as they came floating down the harbour, taking them for armed boats. This somewhat ludicrous engagement was afterwards known as the "Battle of the Kegs."

Twenty years after this event another American, Fulton by name, laid a plan "for submarine" defence before the French, which, as he declared, "*would rid them and all the world of British oppression.*" The French, however, do not seem to have felt so sure of it, and Fulton in disgust came over to England and laid his scheme before our Government. He seems to have thought it prudent to conceal his identity from the French, and was always known by the name of Francis on this side of the channel. Pitt, who was then Prime Minister, was greatly impressed with the importance of Fulton's scheme, and a commission was appointed to report upon it, but the verdict was unfavourable. He tried several experiments, but without success, and Lord St. Vincent said that "*Pitt was the greatest fool that* *ever existed, to encourage a mode of warfare which we who ruled the seas did not require, and which, if successful, would deprive us of that rule.*" Fulton, after his failure here, went back to America, and there we lose sight of him.

The next person who appears on the scene in connection with torpedoes is Colonel Colt, known as the inventor of Colt's revolver, and I believe he was the first person to apply the electric current as a means of igniting submarine charges. The American Government instituted a series of experiments, and in 1842 Colt succeeded in totally destroying the "Boxer," a gunboat which had been placed at his disposal for that purpose. After his death they found among his papers hints at his having made some further discovery, but the secret died with him. During the Crimea torpedoes were extensively used by the Russians in the defence of Sebastopol and Cronstadt, but, owing to the extreme vigilance of the allies, no great mischief was done by them. The next scene is the great civil war in America, and here for the first time the torpedo takes a really prominent part both as an offensive and a defensive weapon. The Confederates, with their vast extent of coast and the number of their navigable streams, had no navy to cope with the well-organised fleets of the North, and what fortifications they possessed were quite inadequate to the task of resisting the Federal ironclads when they attacked in force. Under these circumstances they had to resort to other means of defence, and they consequently directed their attention to submarine warfare. In their hands the torpedo assumed quite a new aspect, and there were not a few instances where they used it with terrible effect.

Among others, I may cite the case of the "Patapsco," a monitor which was sunk by the explosion of a torpedo, with the loss of sixty-two men, and the "Commodore Jones" also.

Such is a brief history of the torpedo. We have now to examine the various principles upon which they have been constructed. The three principal methods which have been employed for exploding torpedoes are—

1st. Acids.

2nd. Percussion; and

3rd. Electricity.

Many other plans have been tried at different times with more or less success, but as they do not play a very important part, I will not weary you with a description of them. Torpedoes fired by acids were much used by the Russians in the Crimea, and it is said that the acid fuze was invented by Jacobi, the great Russian chemist. One form of this fuze is shown in fig. c in this diagram. I have shown all the fuzes in section, so as to make their construction plainer.

In the centre of the fuze is a glass tube filled with sulphuric acid and closed at both ends. This tube is entirely surrounded by a mixture of chlorate of potash and fine white sugar. The whole is enclosed in a leaden pipe closed at the top end, which is exposed to the weather, but open at the bottom, which is inside the torpedo. The lower part of this tube is filled with a priming charge of mealed powder. The whole thing is screwed into the torpedo by the brass nut. Now if any large body comes roughly in contact with the leaden pipe, it will bend it, and in so doing breaks the glass tube. The sulphuric acid is then mixed with the chlorate of potash and sugar, and in so doing it produces a yellowish sort of gas which is very explosive and becomes decomposed at a very moderate temperature when in contact with a combustible material. The contact of the acid with the potash developes the gas and produces sufficient heat to explode the compound. The whole charge is then fired by the medium of the mealed powder. There is some danger in laying down torpedoes armed with this fuze, that the boat employed on the surface may knock against the leaden pipe and thereby explode the torpedo. To obviate this danger, an ingenious modification of the fuze has been invented, in which the leaden tube is itself fitted loosely into a large pipe up to a few inches of the top. The space between is then filled with a strong cement, which is, however, voluble in water. Before laying the torpedoes the fuzes are filled with cement, which is allowed to harden. In this state it is quite impossible to bend the tube. After the torpedoes have been laid a few hours, the cement gradually softens, and then if the fuze receives a blow it will bend the pipe and explode the torpedo.

Acid fuzes vary in form according to the style of magazine they are used on. The principle, however, is always the same; so I need not detain you with further descriptions of them.

We now come to percussion fuzes, and torpedoes fired by this means were employed during the American war in greater number than any other description. Fig. D, on the same diagram, gives a section of one of the most general forms of percussion fuze. The fulminate which you see in the centre of the fuze is contained in a wooden tube in connection with a priming charge of some quick burning material. The tube is enclosed in a wrought-iron case, and is supported by a collar. The fulminate is covered over by a cap of thin copper, and outside this is a strong cap of brass. The outer cap is made sufficiently thick to withstand any ordinary blow, and this is a very necessary precaution, as the copper cap is made to crush in with a pressure of about ten pounds. These sections of fuzes are all enlarged several times to make them plainer.

On another diagram and Fig. B we have the section of a torpedo known as Singer's. It did great execution in the American war, and is here represented about half size.

The case of the torpedo is made of wrought-iron, and is divided into two compartments, the upper one is simply an air chamber to give it buoyancy, and the lower one is filled with powder. On the top of the case is a heavy cast-iron cap, loosely put on, but prevented from falling off by a low rim from the under cover entering an aperture in the centre of the cap. As you see, there is an iron bar running through the centre of the case and projecting some distance underneath. Inside the magazine is a rod of iron that works loosely in two rings fixed to the bar. The upper end of this rod fits into a cap filled with a fulminating compound. It is kept from falling out by a pin in the lower end. Directly underneath the bar is an iron plunger, which can be confined by a strong spring and retained in that position by a pin in the upper ring. The mooring rope is rove through the eye at the bottom. If a ship comes in contact with a torpedo, it will knock off the cast-iron cap, and as this is fastened by a lanyard to the trigger, it will pull it out and liberate the plunger. The blow is then imparted to the rod in the magazine, and it, in its turn, explodes the fulminate in the cap. In the bottom ring, which holds the plunger, is shown a safety pin, which can be withdrawn when the torpedo is moored by means of a line on the same diagram. I have given the elevations of two torpedoes, which can either be filled with acid or percussion fuzes. Fig. A was a very popular type with the Confederates, as it was easily made and inexpensive. The body of the instrument is, as you see, a cask.

Beer barrels were the most in request for the purpose, as they were the strongest and the most carefully made. The barrels were first coated inside with pitch to render them perfectly water tight, and then to each end was fixed a cone of zinc. This answered the double purpose of rendering the cask more buoyant and giving a form of less resistance to the water. This is the most important point, as the torpedo is less likely to form eddies and ripples over it, and thereby attract attention; besides which, the less resistance it offers to the current, the smaller will be the anchor required to moor it. The band is strapped with rope, to the bight of which a weight is made fast, sufficiently heavy to keep the barrel in its proper position, as otherwise the weight of the fuzes would cause it to capsize and bring them on the under side. The mooring line is also made fast to the same rope.

Fig. C shows the shape of a torpedo that was designed to prevent as far as possible any chance of its being fished up. The magazine is of copper, and will hold from 70 lbs. to 120 lbs. of powder, according to the size required. It is fastened to the end of a long spar, which is secured by a ring to the mud anchor. When in the water the spar keeps an upright position, as shown here. If grapnels or ropes are being used to fish for torpedoes, they will pass over it, or, if the bight does come across it, the spar will bend and let it pass over.

Numerous other shapes have been used for torpedoes, but these two will give you a rough idea of the kind of thing.

In some of their harbour defences the Confederates used numbers of piles driven into the ground diagonally and pointing towards the enemy. The points of the piles were armed with heavy shells fitted with percussion fuzes. You can form some idea of them from the one I now hold in my hand, although it is much smaller. I was in Paris shortly after the Commune, and amongst other odds and ends, brought this back with me. It is one of the percussion shells, filled with petroleum, which the Communists fired at the public buildings to set them on fire. It is, however, just the same shape as the pile torpedo and about one-fourth the size. Before quitting this part of my subject, I ought to say a few words about torpedo boats.

Several boats were constructed during the American war, the intention being to entirely or very nearly submerge them, and when under water to explode a torpedo rigged out on a boom against a ship's side. *The two great difficulties are the motive power and steering them when under water.*

For the motive power steam is not admissible, as in the first place the smoke from a funnel would lead to the detection of the boat, and it is impossible to keep a supply of air sufficient to feed the fire. As to the steering, we can only judge from experience. It frequently happened, that after going for a few miles, as they thought, under water, the boat rose to the surface in precisely the same place as she went down. There is, however, one memorable instance in which a torpedo boat succeeded in sinking a ship. A section of her is given in the diagram you now see. I refer to the gallant attack of Lieutenant Dixon on the United States ship "Housatoine," as she lay outside Charleston Harbour during the blockade. The boat was about 35 feet long, and was built of boiler-iron. "Soon after her arrival at Charleston, Lieutenant Paine, of the Confederate Navy, with eight others, volunteered to attack the Federal Fleet with her. While preparing for their expedition, the swell of a passing steamer caused the boat to sink suddenly, and all hands, except Lieutenant Paine, who at the moment was standing in the open hatchway, perished. She was soon raised and again made ready for service. Lieutenant Paine again volunteered to command her. While lying near Fort Sumter she capsized, and again sank in deep water, drowning all hands except her Commander and two others. Being again raised and prepared for action, Mr. Aunley, one of her constructors, made an experimental cruise in her in Cooper River. While submerged at a great depth, from some unknown cause she became unmanageable, and remained for many days at the bottom of the river, with her crew of nine dead men. A fourth time was the boat raised, and Lieutenant Dixon, of Mobile, of the 21st Volunteers, with eight others, went out of Charleston

Harbour in her, and attacked and sank the Federal steamer 'Housatoine.' Her mission at last accomplished, she sank for ever, with her crew. Nothing is known of their fate, but it is believed that the boat, with the impetus with which she was going, got jammed in the hole caused by the explosion, and could not extricate herself."

From this account we see that the "David," as she was called, killed thirty-one men before she disappeared for the last time.

I must, however, say, in justice to submarine boats, that I saw one about a year ago in New Zealand, built for the purpose of working at the gold in the bed of a river. She was driven by compressed air, and seemed to answer her purpose very satisfactorily.

Before proceeding with the next part of my subject, which is electricity, as applied to torpedoes, I had better explain one or two terms which I shall frequently made use of, and which might otherwise be confusing.

A *conductor* of electricity is any material that will allow a current to pass along or through it, as for instance metals and liquids

A non-conductor or insulator is a substance which stops the passage of a current such as glass or india rubber. Every conductor offers a certain amount of friction to a current passing through it, that is to say the current has to exert a certain amount of strength to get through the conductor. This friction is called resistance. The better a conductor is the less is its resistance. If you have to run off the water from a cistern, you can do so very much quicker by means of a large pipe than by a small one. In the same way the larger the surface you give to the electricity to pass over, the less will be the resistance opposed to it. The standard for measuring the resistance on electricity is the amount which a wire of pure copper and No. 16 gauge will give to a current. That amount of resistance is called one Ohm, after the electrician who established the laws of resistance; German silver has about thirteen times less conducting power than copper, therefore a wire of German silver about 135 yards long will give as much resistance as a mile of copper wire of the same diameter. On this principle are constructed resistance coils, which consist of German silver wires, of different lengths, wound on bobbins of cord. In the box I have bobbins which will give a total resistance of eleven thousand Ohms. On putting resistance on the path of current you reduce the strength of a current, but if you pass a powerful current through a very small conductor it will generate heat—you can see that by the following experiments. I will now pass a weak current through this fine wire, and you see there is no result. Now I will pass a strong current through it, you see the friction has caused heat and the wire is fused. A galvanometer is an instrument for detecting the presence of and measuring the relative strength of various currents. It consists of a compass needle suspended in a coil of wire, when a current is sent through the wire it forces the needle out of its natural position, or, as it is technically termed, deflects it. In the galvanometer I have had there is a small mirror fastened to the needle, and a light thrown on it, so that when the needle is deflected by a current you will see a spot of light move on the white scale. The stronger the current the farther it will move.

However close you hold the two poles of a galvanic battery you will not get a spark, as the electricity has not the energy to leap across the intervening atmosphere, such a current is said to be of low tension. With an apparatus like the induction coil, on the contrary, I can obtain sparks of nearly an inch in length, and these are of high tension. Turning to Fig. B you will see a section of what is known as Abel's tension fuse. It consists of a cord with a chamber turned on the bottom or flat end. Through the other end is inverted a rod of gutta percha with two small copper wires in it. These copper wires project a little through the end of the rod, and the ends are laid bare, and a small quantity of Abel's priming composition is put round them.

The other ends of the wire are twisted back over the top, and put through two holes drilled in the wood, after which small copper tubes are driven in, to insure good contact. The chamber in the bottom of the cylinder is then filled with powder and the bottom plugged up. To attach the wire to the fuse it is only necessary to put them through the two holes, and to bend them back to hold them firm. To fire these fuses you are obliged to use electricity of high tension, the current goes down the one wire, and through the priming composition, which is a bad conductor of electricity, to the other, but in so doing fires it. These fuses are very good for mining purposes, but for torpedo work are not much good, as it is almost impossible to test them. I found one the other day to have a resistance of more than 55,000 Ohms. In consequence of this difficulty, the Government have adopted fuses which depend simply upon the heating effect of the galvanic current. Fig. A of the fuse diagram gives an enlarged section of a platinum fuse. The two copper wires are passed through a clorite rod, and the ends left exposed for a short distance. Across the two ends is soldered a piece of very fine platinum wire. A cap of the same material fits on to the rod, and is filled with powder or gun-cotton. The action of the fuse I have already explained to you. Electric torpedoes are worked on two principles, those in which the enemy's ship is left to close the circuit, and which are known as contact self-exploding torpedoes, and those which are exploded from shore.

I am sorry to say that from want of time I was unable to complete any diagrams to illustrate this kind of torpedo, but I can show you the principle with the universal discharger. I connect one end of the discharger with a battery, putting a fuse in circuit. I shall fire this fuse by means of the induction coil which is supposed to be ready for action on shore.

You can readily understand an apparatus fitted up in the torpedo by which a ship would hit a sort of buffer projecting from the side of the case and so close the contact. Here is the buffer, or sliding bar, which projects from the side of the torpedo into the water. In this position the end of the bar inside the case is at a safe distance from the other terminal.

We will now suppose a ship to hit the buffer, the consequence is that it pushes it onwards and as soon as the two inner ends are within striking distance the fuse is fired. The mechanism by which this contact is completed is very intricate in some sorts of torpedoes, but the principle is always the same. Of the second class, namely those fired by a key from the shore, I will give you two instances. The first is worked from one station, and will be made plainer if we look at the diagram illustrating it. I will first point out the connections on the diagram and then we will go through the whole operation of testing and firing the fuses. As you see, there are five torpedoes, which are all connected. The spot is marked D, and which I will explain presently. E is what is termed the earth-plate. As the water is a conductor, it is unnecessary to lay two wires to the torpedo; instead of so doing we simply connect one pole of the battery with a plate of metal which, stuck into the earth or in the water, as the case may be. A current then passes from the wire, which is left exposed outside the torpedo, and returns through the water to the earth-plate and so on to the battery. The dial is simply an apparatus for connecting the battery with any torpedo at pleasure, each one being connected to one of the studs. On the one side is the firing and on the other the testing battery and galvanometer.

Suppose we have fired one of the torpedoes, the end of the wire leading to that particular one would be left bare in the water, so that if we put the moveable arm into that stud and pass a testing current through we should always get a deflection, so that if a fresh operator was at work in the station and tested that wire, unless he tested it with a Wheatstone's bridge he might think there was a torpedo still ready for action there. What we want to do, therefore, is to break the connection with that wire altogether, and this is effected in the following ingenious manner. At the joint D, a fuse similar to the torpedo fuses is included in each circuit. Through the small cap of the fuse is driven a pin which runs between the two exposed ends and under the platinum wire. When the fuse is exploded the cap is shot off, and in so doing the pin tears through the platinum wire and so breaks the circuit. The whole is inclosed in a strong cap screwed on over it to prevent the water getting at it and completing the circuit. The disconnector is particularly useful in self-exploding contact torpedoes.

We will now proceed to test our torpedoes and then to fire them. The direction of the testing current is indicated by red arrows, and the firing current by black ones.

There are systems for firing torpedoes, which are much more perfect than the one I have just shown you; as, for instance, one by which they can either be fired from shore or by the ship herself: you have, however, seen quite enough to prove that, if properly managed, they can be worked with the greatest ease and certainty.

The method of introducing the wires into the torpedoes is shown in Fig. E, and, as you see, there are three fuses, so that if one is deficient the current will pass through the next.

The destructive force of powder is chiefly in the direction of least resistance, so that the amount of damage done to a ship depends whether the hull at the point of explosion offers a greater or less resistance than the weight of the column of water close to the torpedo at the same point; so that the deeper the torpedo is submerged the greater chance there is of its expending its force on the ship if it is close enough to her. From this we deduce the following rule—*that the distance between the ship and torpedo should be as small as possible, while the depth to which it is submerged should be as great as possible.*

In casing gunpowder the case ought not to be less than half an inch thick, especially with large charges, or otherwise the pressure of the gas will burst the case before the whole charge is ignited. Gun-cotton is so much quicker in its action that the wire cases do as well, and it is not even necessary to keep it dry if you have a primary charge of dry gun-cotton inside it. I will not weary you with any further facts about torpedoes, but will conclude by showing you a few of the most striking effects to be obtained from a powerful battery: (1) fuse wires; (2) platinum silver chain; (3) platinum lamp; (4) electric light.

The lecture throughout was illustrated by a most brilliant series of experiments, all of which received great applause; the most favour, however, being awarded to the exhibition of the electric light. The meeting was decidedly the most successful the Society has ever had since its foundation, and the thanks of all are due to Mr. Pender, for the energy he bestowed on the preparation of his lecture.

The President on moving a vote of thanks, observed that the popularity of the lecture was the best refutation of the conventional tirades against the doings of the Society.

The head of the school then called for three cheers for the lecturer, which were most heartily given, and testified to the popularity of his lecture.

M. D. MALLESON,
Secretary.

On Saturday, December 5th, Canon Tristram gave a lecture on the "Natural History of Palestine," in the great school, and illustrated it by numerous stuffed animals which he had collected during his tour in that country. The following is an account of the lecture from short notes taken at the time, and we must apologise for any slight inaccuracies that may occur:—

He began by saying that classification is the first thing to be considered in natural history. A tradesman, in clearing out his till, finds gold, silver, copper: That is the first way of classifying the money. Then follow other ways of analysing it. He may come upon a George IV. halfcrown. There may have been two dies struck in one year; coins of another country may have slipped into the till; he may find a guinea or a seven-shilling piece; then he will find out that there were no seven-shilling pieces coined after the year 1812, and no sovereigns coined before the year 1817. He may also come upon a bad penny, or a worn-out Roman coin, or any such things as these; and then, when he has found out all these things, let him collect his thoughts.

The Holy Land is a common-place country in every respect. If you go a journey from Arcadia and Argolis into the Holy Land, the country you go through is *most* common-place; but there is a variety in it which exists in no other country. Naturalists divide the country into zones as we do into continents. The chief of these zones are *Palæarctic*, *Nearctic*, *Indian*, *South-American*, *Australasian*. With these, deserts mark boundaries more than seas.

The Holy Land is the centre of natural history. It is included in the first three zones, and consequently in the Holy Land we have a great variety. . . . The Rev. Canon had to write on the fishes of Galilee for "Smith's Dictionary." He fished there, and was surprised to find that there was no collection of fishes like it anywhere. Travellers pass by and do not notice them; but it is a case of "Eyes or no Eyes" again. He caught five new species, which he found were allied in their *genus* to those at Zambesi, the Nile, &c.

About the Dead Sea there are many other different things. Birds, for instance, and plants. On Hermon the Rev. Canon obtained a *vole* running into a hole in snow. He broke up the snow, and in so doing crushed the *vole*, which proved to be not half the size of our rat. Its *first cousin* lives on the top of the Pyrenees, Alps, and Carpathians. A bird also was found on Hermon, which resembles a *chough*, though it is not that bird. Its *first cousin* dwells on the Alps, which is just like it, and is found nowhere else. One day, on examining some old tablets at Beyrout, north of Lebanon, he happened to take a shell out of a crevice in a rock, which was something like a bone. He examined the rock, and saw the constructor of the road had cut down the side of the rock to make it wider. He went down the rock, and came upon some bright red soil, which he examined. Above there was a cave, which was composed of a mass of bones, earth, lime, and chipped flints. There is no such flint within forty miles of that place, and so some one must have brought it, and, therefore the place must have been inhabited. He climbed down to the sea, and found at the bottom of the rocks large blocks mixed with natural rocks.

There were also found teeth of ibex, red deer, elk, reindeer, bison, and *onyx*. Assyrian kings used to hunt the onyx, of which there is no trace except the teeth. David is the last writer who mentions it, and Assyrian monuments one thousand years B.C. describe it, but no later.

The Rev. Canon killed 1,864 birds, of which there were 367 species. It is very difficult to tell where the species begins and ends. There is a *jay*, something like our *jay*, but not exactly; something like an Algerian jay, and also the jay of Asia Minor, but with a distinguishing feature. Their *squirrel* is cousin to ours. The *sparrow*, inhabiting the Red Sea, has yellow on each side of its throat, and you have to go as far as Formosa, beyond China, to find such another. Their *mole* is something like ours, only it has an eye, a very small one, in the middle of its forehead. Their *starling* is first cousin to the one found in the Cape of Good Hope. They both have saffron about them, but belong to a distinct *genus*. The Rev. Canon shot *three* kingfishers (whose *general* slaughter he deprecated in strong terms); they were like the English kingfisher, and its first cousin was found on the African coasts and Red Sea.

Next an *owl* was exhibited, which catches fish in its feet by dashing them into the water. There is no specimen of this bird found nearer than the west of India, where is the same *identical* bird. A *cat* was next exhibited, which caused great amusement; it is wild, and is first cousin to the African one. A *sun-bird* was here shown round: it has nothing to do with our *humming-bird;* is a very pretty bird, and is conscious of its beauty: found, besides the Holy Land, in *Africa* and *India* only. A *long-tailed thrush* was the next exhibition, found at the base of the Dead Sea: found only in India, the oases of Africa, and the Sahara besides.

Next came a *coney*, found only in Arabia Petræa and the Holy Land. Its first cousin is the hippopotamus (this remark was received with shouts of laughter). Its nails are very short, and it has no sharp teeth; its teeth are like the teeth of the horse and rhinoceros. Its foot reminds one of an elephant's foot. Found in the Cape of Good Hope and Abyssinia.

The lecturer then discussed the question, how these animals came to be here, and in Africa and India as well. To use his former metaphor, "we had counted out the till, now let us account for it." If we looked at geology, just before the world began, there was a period of intense cold (so geologists say), called the glacial season. Man was created after the glacial epoch. In Norfolk and Suffolk there is a great deal of *boulder* clay on the cliffs, and below it *peat*. This boulder clay was probably washed down by the glaciers, in the glacial season. The size of the clay is various, some pebbles, some bits weighing a ton. Before the glacial season there was a period of heat, and so we find below the *boulder* clay and peat. Animals must have lived in intense heat and been killed by the cold.

Now birds about Africa have nothing to do with Africa. This is the notion of accounting for it: during the *hot* season, it is supposed that Africa and India were under water, and it is supposed a great continent stretched from Madagascar to Ceylon, and that, if this was the case, these birds are the descendants of those who managed to survive. If this continent did really exist it would just have taken in the Dead Sea, and so account for the country about the basin of the Red Sea, the Dead Sea, waters of Merom, having the same kind of birds. When glaciers came down from Lebanon, the birds naturally went to the Dead Sea, as it was hotter there than anywhere else; whereas in the north, the reindeer, bison, onyx, &c., remained on the top of the mountains.

The Rev. Canon ended up with a few words of advice to naturalists, whose sole duty, he said, was to *observe:* all creatures in the Holy Land came from within fifty miles of each other, and yet they illustrate all continents. No country in the whole world is so various in its animals.

Present, 150.

M. D. MALLESON,

Secretary.

The average attendance during 1874, has been 75 $\frac{5}{12}$ ths, which shows the increasing popularity of the Society in the school.

M. D. MALLESON,
Secretary.

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